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Occupational safety and health performance in the Pakistani construction industry: stakeholders' perspective

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Abstract:

Lack of compliance with Occupational Safety and Health (OSH) has resulted in a relatively higher construction accident rate in developing countries such as Pakistan. This study attempts to unveil the aspects of OSH that are ignored and discern the differences in the perceptions of key construction stakeholders. Data collected from 195 respondents were analysed using Cronbach's coefficient alpha, Shapiro–Wilk and Kruskal–Wallis tests. The results indicate that OSH training is the most neglected factor, followed by non-inclusion of safety in contract documents and workers' non-involvement. Stakeholders have dissimilar perception about three OSH factors, including management commitment to OSH, safety rules/procedures and policies, and OSH training. Regulatory authority is suggested to launch OSH awareness campaigns, announce safety incentives, institutionalize the OSH certification system, and incorporate safety credit points in contractors' registration process. Though this study pertains to Pakistan, the methodology and the recommendations can be generalized for other developing countries with a similar work environment.

Keywords: OSH factors; OSH practices; performance indices; Kruskal Wallis test**;** stakeholders; construction industry.

Introduction

Construction is not only considered to be one of the most significant industries in terms of its contribution to the economic growth (Le et al. 2014) but also in terms of its impact on Occupational Safety and Health (OSH) of the workers (Suazo & Jeselskis 1993). The construction industry (CI) employing the largest labour force in the world has accounted for about 11% of all occupational injuries and 20% of all deaths (Nandakumar 2007). Accidents and their interconnected damages caused to the equipment, property and the workers, generate adverse effects on the overall productivity. These accidents mostly occur due to the ever-changing site conditions, varied human behavior, and unsafe work procedures (Abdelhamid & Everett 2000). Similarly, technological advancements have also stimulated a more perilous working environment (Ahmed 2013).

In the developing countries, business strategies are not woven with OSH regulations (Lodi et al. 2008) and CI still relies on labor force (Yi & Chan 2014), encompassing 2.5-10 times more workers for each activity (Koehn et al. 1995). Pakistani CI, having a share of 2.5% in the GDP, employs 7.4% *(4.424 Million)* directly and 30-40% indirectly of the total labour force (PBS 2013). Unsafe OSH conditions still exist on various construction sites, resulting into cost overrun, time delay, and low productivity (Farooqui et al. 2008). Major hurdles in OSH implementation are identified as; no cooperation from the workers, non-familiarity with safety management techniques, owner's disinterest, and absence of a regulatory authority like Occupational Safety and Health Administration in the United States (Farooqui et al. 2007; Ahmed 2013; OSHA 2014). Even though safety clauses are incorporated in the contract documents, these are not rigorously enforced (Ali 2006). Similarly, accident statistics are not

maintained at the industry level. Establishment of a national level organization is therefore necessitated by Choudhry et al. (2008) for the development and enforcement of OSH standards.

The nascent step towards this development is to ascertain the weaknesses in the current OSH practices, using the leading indicators of safety practices and site investigations (Mearns et al. 2003; Flin et al. 2000). The objectives of this study are set as; carry out an in-depth analysis of the current OSH practices; analyze the key stakeholders' perspective including the clients, consultants and contractors; and recommend the measures for augmenting the OSH performance of the Pakistani CI. The methodology and the recommendations would also be applicable to other developing construction industries having similar OSH conditions.

Research methodology

Quantitative research approach (i.e. survey questionnaire) was primarily used to solicit the opinion of the key stakeholders in the CI. Questionnaire survey, being an effective tool to measure the people's perception (Spector 1994) was conducted from November 2011 through March 2012 in all the major cities of Pakistan. Site visits were also conducted to help the frontline workers in questionnaire filling as some of them were not literate enough, though experienced, to read the contents of the questionnaire. Respondents were asked to grade the performance level of each OSH practice on their work-site. Performance Indices (PI) for all OSH factors and their related sub-factors (practices) were calculated using the Statistical Package for the Social Sciences, and then good and neglected safety aspects were sorted out. Cronbach's coefficient alpha value was used to evaluate the internal consistency (reliability) of the questionnaire, whereas Shapiro-Wilk normality test was performed to check the data distribution (normality). Kruskal Wallis test was then conducted to explore the consistencies and differences

in the perception of key stakeholders including the clients, consultants and contractors. Level of significance (Sig.) was set as 0.05 for the statistical analysis.

Questionnaire design

Comprehensive literature review was carried out to design the questionnaire for assessing the current OSH practices. Questionnaire was mainly extracted from three sources (Choudhry et al. 2009; Choudhry & Masood 2011; HSE 1997). Similar questionnaires had been used by Choudhry et al. (2009) and Hon et al. (2013) for the CI of Hong Kong, which were primarily extracted from the *71 items safety climate survey tool* of the UK Health & Safety Executive (HSE 1997). Choudhry & Masood (2011) had also used similar questionnaire with some modifications for the CI of Pakistan.

To enhance the *validity* and *practicality* of the designed questionnaire, it was pilot tested through twenty experts from the academia, industry and the Government departments like National Highway Authority, National Engineering Services of Pakistan and Pakistan Engineering Council (PEC). Distribution of the experts was; clients (4), consultants (6), contractors (7) and academics (3). Modified questionnaire had an introduction to the respondents covering their name, qualification, experience, organization, working level and the group which they represent. It was followed by sixty OSH practices, clustered into thirteen major OSH factors. Last part comprised of four critical questions related to the OSH management system, namely; allocation of budget for OSH compliance, frequency of toolbox talks, post-accident response mechanism, and responsibility for safety of employees.

A five-point Likert scale, with 1 showing very low performance level and 5 showing very high performance level was used in the questionnaire to measure the PI values, separately for the

clients, consultants and contractors. Equation 1 was used to calculate the PI values for each OSH practice (Enshassi et al. 2009; Holt 1997).

$$PI=[1(n1)+2(n2)+3(n3)+4(n4)+5(n5)]/[(A)(N)] \quad (1)$$

where *n1, n2, n3, n4* and *n5* represent the number of respondents for very low, low, moderate, high and very high level of OSH performances respectively, *A* is the highest weight (i.e. 5), and *N* is the number of respondents (i.e. 195).

Sample size

Sample size representing the targeted population (Shash & Abdul-Hadi 1993) was determined using Equation 2.

$$n=(n')/(1+n'/N) \quad (2)$$

where n is the sample size from finite population, N is the total population and n' is the sample size from infinite population which can be determined as $n'=S^2/V^2$, S^2 is the standard error variance of the population elements and is equal to $p(1-p)$ $\{S^2$ *is maximum at* $p=0.5\}$, and V is the standard error of sample population which is 0.05 for a 95% confidence level. Nearly four Million people are currently working in the Pakistani CI (PBS 2013) so this figure is considered as the total population *(N)*. Probability of the occurrence of similar answers is presumed to be 50% so the p value is set as 0.5. Using Equation 2, acceptable sample size was calculated as 100; hence a sample of 195 is fairly reliable for this study.

Sampling method

Sampling of the questionnaire is vital as it significantly affects the analysis and findings. Hence, sample should be a good representative of the population. An effort was therefore made to collect the data of diversified projects from different cities, using random sampling technique (Wu et al. 2008). To minimize the possibility of bias, all types of tradesmen were targeted for the data collection. Sample included the input from three main categories of the stakeholders including the clients, consultants, and contractors/subcontractors.

Characteristics of respondents

Two hundred and fifty (250) questionnaires were distributed to the key construction stakeholders, both in public and private sectors. One hundred and ninety five (195) valid responses were received indicating an encouraging response rate of 78%. Among the respondents, 27% worked for the clients, 31% for the consultants and 42% for the contractors/subcontractors. Respondents had a rich working experience, as 84% had more than 5 years of experience. Frequency of respondents as per their working level is; managers (39.5%), field engineers (27.7%), supervisors/foremen (12.3%), frontline workers (11.3%), and safety officers and safety inspectors (9.2%). Distribution of the respondents as per their PEC categories is shown in Table 1.

Insert Table 1 here

Respondents to this survey were chosen from 47 construction companies, working on 61 diverse civil engineering projects, spread over 16 major cities of Pakistan. Location wise distribution of the construction projects is; Islamabad (14), Rawalpindi (9), Lahore (11), Karachi (8), Azad Kashmir *(Bagh, Muzaffarabad and Rawalakot)* (6), Gujranwala (3), Federally

Administered Tribal Areas (2), Gilgit (2), and one each at Fateh Jhang, Mansehra, Khushab, Sargodha, Bahawalpur and Dera Murad Jamali. More emphasis was given to get the response from the high rise buildings, bridges, flyovers and tunnels, as higher degree of safety standards is needed on such projects. Type of projects included in this survey are; high rise buildings (11), residential buildings (5), non-residential buildings (13), educational buildings (7), roads (8), bridges/flyovers (5), dams (2), hospitals (2), tunnels (3), runways (2), hydroelectric (1), mobile tower (1), and canal (1). Thus, it can be safely concluded that the collected data truly represents all sectors of the CI.

Analysis and results

Reliability and validity of the data

'Reliability refers to the consistency of a measure and to the probability of obtaining similar results if the measure is to be duplicated' (Oppenheim 1992, p.144), whereas *validity* determines whether the score or question can measure what it is intended to measure (Carmines & Zeller 1979, p.17). To ascertain and enhance the *reliability* and *validity* of the questionnaire, it was pilot tested as explained in questionnaire design section. It resulted in modification, addition and deletion of some of the OSH practices. Data validation and reliability analysis were also performed using the most common measure of internal consistency i.e. Cronbach's coefficient alpha value. Its value is measured as 0.914 (Table 2) which is reasonably higher than the acceptable value of 0.7 (Alaghbari et al. 2007), hence the data have excellent internal consistency and reliability for further analysis.

Insert Table 2 here

Normality test

If the sample size is less than 2000, 'Shapiro Wilk normality test' is carried out to check the normality of the data (Royston 1982). For the data to be sufficiently normal, the sig. values must be higher than 0.05. Results of normality test indicated that the sig. value for each OSH practice was less than 0.05, implying that the collected data were not normally distributed.

Differences in the stakeholders' perspective about OSH factors

As the collected data were non-parametric (not normally distributed) so Kruskal Wallis test was undertaken to check whether the key stakeholders including the clients, consultants and contractors/subcontractors, have similar perception regarding the performance level of each OSH factor or otherwise (Kruskal & Wallis 1952). Sig. values of less than 0.05 implied a variation in the perception of key stakeholders. Besides uncovering the most neglected OSH factors including the OSH training, inclusion of safety in the contract documents, safety meetings and workers' involvement; Table 3 reveals that the key stakeholders have similar perception about performance level of nine OSH factors whereas they differ about three factors, namely; *management commitment to OSH, safety rules/procedures and policies* and *OSH training*. These factors were further analyzed by finding the sig. values of their related OSH practices.

Insert Table 3 here

Kruskal Wallis test for selected OSH practices

Twenty one OSH practices related to *management commitment to OSH* (9), *safety rules/procedures and policies* (6) and *provision of OSH training* (6) were further analyzed using the Kruskal Wallis test. Sig. value of each OSH practice (Table 4) illustrates that out of nine

OSH practices associated with *management commitment to OSH*, stakeholders differ in their perception only about two, namely; 'OSH is given priority over productivity by the higher management', and 'workers have no time pressure'. Similarly, stakeholders differ in their perception about three OSH practices related to *safety rules/procedures and policies*, namely; 'safety audits are conducted regularly', 'workers are medically examined regularly', and 'insurance coverage is provided to the workers'. Likewise, for the factor of *provision of OSH training*, stakeholders differ about two OSH practices, namely; 'organizational charts showing the names, positions and responsibilities for OSH compliance are displayed on work-site', and 'OSH refresher training sessions are periodically conducted for all the workers'.

Insert Table 4 here

Performance indices for selected OSH practices

Seven OSH practices for which the key stakeholders have given varied opinion were further analyzed using their PI values so as to identify the group having distinctive perception. Results in Table 5 have revealed that the differences in the opinion of stakeholders are primarily due to the lower grading given by the consultants; however, clients and contractors had almost similar perception. The consultants are usually well aware of the OSH standards therefore they have relatively given lower grading than other stakeholders. Consultant's advice should therefore be pursued to augment OSH compliance. On the contrary, the practice of 'organizational charts displaying the OSH responsibilities on work-site' had been given higher PI value by the contractor, whereas consultants and clients had graded it much lower. It indicates that the representatives of the contractor tend to exaggerate their ranking, especially against those OSH

factors which are questioning about their responsibilities. Contractors should therefore be recommended to enhance their OSH standards at par with the expectations of other stakeholders.

Insert Table 5 here

Analysis of current OSH practices

Sixty OSH practices were ranked based on their PI values. Good construction safety practices were observed as: hoists, cranes and mechanical equipment are always inspected before start of their operations; objects are always fastened and inspected before lifting them; sufficient lighting arrangements are made where ever needed; ventilation is ensured at confined spaces; medical facility (only the first aid) is readily made available; water for drinking and washing is sufficiently provided as the workers have to work under extreme weather conditions and they need excessive quantity of water; long rest time is given at noon in hot weather conditions; and negligent workers are sometimes counseled.

OSH practices which need drastic improvement (Zahoor & Choudhry 2012) were identified as: OSH training is generally provided to the permanent employees only whereas employees of subcontractors are mostly ignored; workers always try to become macho man and have an allure to work under avoidable hazards; representatives of the subcontractors are not invited to attend the safety meetings; job-specific OSH training is not provided before the start of a job; contractors are not bound to prepare and submit the 'OSH plan'; ‘job hazard analysis’ is occasionally carried out, no action is taken in case of any OSH violation by the co-workers; no safety audit is conducted due to the absence of such regulations; organizational charts showing the names, positions and responsibilities of OSH officials are displayed on few sites; time pressure is resulting into a compromise on safety compliance; no reward is given for completing

the task safely however, workers are sometimes penalized for safety non-compliance; no insurance coverage for the temporary workers in most of the companies; and unhygienic site conditions are not uncommon including inadequate availability of lavatories, exposure to hazardous materials and pollution. In short, OSH is not the top priority of higher management and their major focus is on cost, quality and time; however, little attention is paid to safety compliance after the occurrence of an accident.

Analysis of OSH management practices

Four critical questions were asked to identify the weaknesses in the OSH management system being practiced in the CI.

Allocation of budget for OSH compliance

Accident rate can be effectively reduced by investing in OSH (López-Alonso et al. 2013), and optimum cost of the safety investment has been calculated as 0.8% of the project cost (Poon et al. 2008). According to 61.54% respondents, no budget has been allocated for OSH compliance on their work-sites (Table 6). Likewise, 32.3% said that their OSH budget is less than 1% and that too is only for providing personnel protective equipment (PPE) for the workers. 4.61% said that 1-2% amount is allocated for OSH whereas only 1.54% agreed that 2-4% budget is earmarked. It is important to highlight that most of the companies do not have 'OSH policy'; however, mega projects funded by the foreign agencies do have a safety policy and special budget for OSH compliance.

Insert Table 6 here

Frequency of toolbox talks on the project site

According to Table 7, 46.15% respondents said that toolbox talks are never held on their projects, 33.33% responded that these talks are organized once in fifteen days, 14.38% said that toolbox talks are held on weekly basis, 4.6% respondents have these talks twice a week whereas 1.54% have it on daily basis. Ideally, toolbox talks should be held on weekly basis (Alkilani et al. 2013), and these are in addition to the daily morning safety talk.

Insert Table 7 here

Post-accident response mechanism

Respondents were asked that which *post-accident response mechanism* is being followed at their work sites. Only 11.8% respondents said that immediate organization level action is taken on their projects whereas 34.36% agreed that only the accident is reported and no further action is taken to reduce the probability of accident occurrence (Table 8). 23.6% agreed that preventive actions are taken to avoid such occurrences in future, whereas 30.25% agreed that only the project manager decides the response mechanism. These results clearly indicate that less interest is taken by the higher management for taking necessary precautionary measures, and it is left to the discretion of lower management only to take appropriate action in case of an accident.

Insert Table 8 here

Responsibility for safety of employees

Ideally, project director should take the responsibility for ensuring safety of his employees on work-site whereas safety staff should be employed for advice and assistance (Choudhry et al. 2008). 16.41% respondents agreed that the project director is responsible for ensuring site safety,

whereas 27.7% responded that safety officer is made responsible for ensuring OSH (Table 9). More alarmingly, 31.8% respondents said that employees are themselves responsible for their safety. Likewise, 18.97% and 5.13% respondents voted for construction manager (site) and field supervisor respectively, to be responsible for ensuring safety. This clearly indicates that higher management does not take much responsibility for OSH compliance whereas it is left to the discretion of safety officer and the employees themselves.

Insert Table 9 here

Discussion

Construction is encrusted with multifarious challenges in the developing countries, where development and enforcement of OSH standards are generally dejected (Mohamed et al. 2009). According to Raheem et al. (2011), developing countries like Bhutan, India and Pakistan are suffering from poor OSH compliance due to weak regulatory authority. Though *management commitment to OSH* is emphasized by many researches (Zohar 2000; Flin et al. 2000; Mohamed 2002; Choudhry et al. 2009), it has been ranked 7th among 13 factors in this study, implying that it is still not the top priority of the key stakeholders in Pakistan. Accentuating the implications of management commitment to the safety for the Bangladeshi CI, Hossain et al. (2015) have recommended to formulate a comprehensive safety policy encompassing an effective training plan and encouragements for the employees. Likewise, poor management control often results into an increased work pressure and a compromise on safety compliance in Pakistan. Frontline workers are usually made aware of the importance of OSH through safety signs and posters; however detailed training and briefing sessions are rarely conducted especially for the subcontractors' employees. Toolbox talks are also not regularly conducted. Moreover, workers

are not selected based on their past safety performance and they are employed without proper medical checkup. Emphasis of the key stakeholders is only on improving the quality, reducing the construction time and cutting the overall cost of the project. Similar situation is reported by Kheni et al. (2008) for the CI of Ghana where prime objective of the contractors is to maximize the profit even at the cost of violating the safety regulations. Similarly, no budget is allocated by the client at the time of contract for safety compliance, and only the principal contractor is made responsible for ensuring it using his own resources. Nevertheless, large construction companies have achieved better safety standards as they have started investing in OSH. Similarly, projects funded by the foreign organizations do have a safety budget and they provide adequate safety training and implement OSH standards. The key stakeholders are therefore suggested to work towards the development and implementation of standardized safety regulations which can be followed by the management on construction sites.

Workers' involvement also needs special attention in the developing countries because they employ a higher percentage of workers than the developed countries (Koehn et al. 1995). According to Kulchartchai & Hadikusumo (2010) workers' feedback and their involvement in planning can significantly reinforce the safety management process, however workers are seldom consulted while planning for safety in Pakistan. Workers are also observed to be undeterred about their safety as they tend to be macho man, make shortcuts, and expose themselves to the unnecessary risks. They are quite reluctant to follow safety regulations and do not use PPE willingly. Management accentuates towards providing safety helmets only, whereas other PPEs are not provided to all the workers. Analogous unsafe behaviour of the workers have been reported in other developing economies, like Thailand (Kulchartchai & Hadikusumo 2010), Sri Lanka (Priyadarshani et al. 2013), India (Chockalingam & Sornakumar 2011) and Ghana (Kheni

et al. 2008). It has therefore been suggested by Mohamed et al. (2009) to emphasize more on workers behaviour for achieving better safety compliance, through safety awareness and strict safety regulations.

Even though safety negligence is sometimes noticed by the management and on site counselling is provided to such workers, no incentives are pronounced for completing the job safely. Similarly, insurance coverage is limited to the permanent workers. Larcher & Sohail (1999) have emphasized that OSH performance can be improved if safety incentives are provided by the clients and the contractors, like the launching of *Pay for Safety Scheme* (PFSS) in Hong Kong (Choi et al. 2011). The Government of Hong Kong has actually changed its strategy from safety enforcement to safety promotion and this paradigm shift resulted in a great decrease in the accident rate from 219.9 per 1000 workers in 1996 to 41.9 per 1000 workers in 2014 (OSHC 2015).

Health issues are also ignored on the work-sites, especially in the remote areas. Employees working in the vicinity of any concrete laboratory, steel cutting and bending areas, carpentry shop and mechanical workshop are more prone to health issues. Social pressure and drugs are also among the neglected aspects which are adversely affecting the mental and physical strength of the workers. Unhealthy site conditions have also been observed including; working under extreme temperature causing dehydration, exposure to hazardous materials, higher level of noise and pollution, and inadequate availability of rest areas and sanitary facilities. Similar flaws have been reported by Ahasan & Partanen (2001) for the least developed countries. Common diseases among the construction workers are related to skin, inhalation, hearing and hepatitis (Awan 2001). Sometimes these diseases either cross the curable stage or become much expensive to be treated.

The key stakeholders have expressed almost similar perception about the performance level of all OSH factors except three. Generally, contractors have given inflated grading to the OSH factors whereas consultants have graded them lower than the clients and contractors. The consultants being cognizant with the international OSH standards should be consulted for augmenting the OSH compliance. Similarly, contractors need to be advised to enhance their OSH standards at par with the expectations of the consultants. There is also a need to educate the key stakeholders that investing in OSH will not increase the project cost, rather it will eventually reduce the cost and time needed to treat the injured workers. According to Huang & Hinze (2006) and Ahmed et al. (2000), clients can effectively improve OSH standards by: addressing the safety issues at the design stage, selecting safe constructors, having contractual OSH requirements, providing funds for safety incentives and auditing. Clients are therefore guided to ask their contractors to submit the safety plan, carry out job hazard analysis, submit accident investigation reports, and display the organizational charts showing the responsibilities of managers, safety officials, and workers.

Findings of the study can help the project owners and the construction firms to plan their future works with a greater focus on the signified OSH practices. The study would also help the international constructors to efficaciously plan their projects in Pakistan by keeping an allowance for the country-specific OSH environment. Viewing the OSH compliance in the developing countries, in general, and Pakistan, in particular, it is recommended to develop a mechanism to have safety certification system for all construction managers and workers. Regulatory authority is also recommended to take immediate steps of: setting minimum safety requirements for the CI, incorporating necessary changes in the contractors' enlistment criteria for having a safety policy, employing mandatory safety staff, and introducing safety incentives like PFSS.

Government departments may take a lead in promoting safety on their public projects by providing some additional funds, over and above the contract sum. The results of the study may or may not be precisely replanted in other developing economies due to the diversity in their regulations; however, the methodology for discerning the differences in the key stakeholders' perspective can be adopted in other industries and also in other developing countries for investigating the OSH problems related to each stakeholder's group. The recommendations can also be generalized for other developing countries sharing the similar work environment and economic conditions, like Ghana, Thailand and Bhutan, and also at the regional level like India, Bangladesh, and Sri Lanka.

Conclusions

The paper provides an in-depth analysis to highlight the imperfections in current OSH practices, and discern the differences in the perceptions of key stakeholders. The analysis is a true representation of OSH performance of the Pakistani CI. Absence of a regulatory authority, lack of commitment of management towards safety and overall safety unawareness have caused slackness in employees' safety behaviour and resulted in an exacerbated accident rate. Henceforth, it is necessary for the key stakeholders to focus on the most neglected aspects of OSH, including safety training, inclusion of safety in the contract documents, safety meetings and workers' involvement. Differences in the perception of key stakeholders have exposed the inflated grading given by contractors to their safety performance whereas consultants were found to be dissatisfied with the current safety practices. Government authorities are recommended to enforce already developed labour laws through legislation, launch media campaigns to improve workers' awareness of their rights, and establish an OSH administrative body. The PEC is

recommended to work in collaboration with this administrative body to conduct OSH training workshops/seminars periodically for the key stakeholders; develop a mechanism for safety certification and auditing; introduce safety incentives, incorporate safety credit points in the process of contractors' registration and renewal; maintain accident statistics; and develop essential contractual requirements to allocate OSH budgets and staff. The study provides an insight into the safety compliance in Pakistan to the construction professionals, safety practitioners, and international contractors, for improving their safety performance by focusing on the most neglected safety aspects. The methodology for discerning the differences in the perception of key stakeholders, and the recommendations can also be generalized for other developing countries facing similar OSH problems.

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References

Abdelhamid, T.S. & Everett, J.G., 2000. Identifying root causes of construction accidents. *Journal of Construction Engineering and Management*, 126(1), 52–60.

Ahmed, S.M., 2013. A strategic framework to improve construction safety practices in Pakistan. In *International Conference on Safety, Construction, Engineering and Project Management (ICSCEPM 2013), August 19-21*. Islamabad, 9–17. Available at: http://goo.gl/r0FPHP

Ahmed, S.M., Kwan, J.C., Ming, F.Y.W. & Ho, D.C.P., 2000. Site safety management in Hong Kong. *Journal of Management in Engineering*, 16(6), 34–42.

Ahasan, M.R. & Partanen, T., 2001. Occupational health and safety in the least developed countries-A simple case of neglect. *Journal of Epidemiology*, 11(2), 74–80.

Alaghbari, W.E., Razali, A., Kadir, M., Salim, A. & Ernawati, 2007. The significant factors causing delay of building construction projects in Malaysia. *Engineering, Construction and Architectural Management*, 14(2), 192–206.

Ali, T.H., 2006. *Influence of national culture on construction safety climate in Pakistan*. Ph.D dissertation, Griffith University, Gold Coast Campus.

Alkilani, S.Z., Jupp, J. & Sawhney, A., 2013. Issues of construction health and safety in developing countries: A case of Jordan. *Construction Economics and Building*, 13(3), 141–156.

Awan, T., 2001. *Occupational Health and Safety in Pakistan*. Asia Monitor Resource Centre, Islamabad. Available at: http://goo.gl/N6Yfg1

Carmines, E.G. & Zeller, R.A., 1979. *Reliability and Validity Assessment*, Sage publications. Available at: https://goo.gl/jk1a8e

Chockalingam, S. & Sornakumar, T., 2011. Tools for improving safety performance of Indian construction industry-AWH & SIT approach. *European Journal of Economics, Finance & Administrative Sciences,* 35 (35), 15–22.

Choi, T.N.Y., Chan, D.W.M. & Chan, A.P.C., 2011. Perceived benefits of applying Pay for Safety Scheme (PFSS) in construction - A factor analysis approach. *Safety Science*, 49(6), 813–823.

Choudhry, R.M., Fang, D.P. & Lingard, H., 2009. Measuring safety climate of a construction company. *Journal of construction Engineering and Management*, 135(9), 890–899.

Choudhry, R.M., Fang, D.P. & Rowlinson, S.M., 2008. Challenging and enforcing safety management in developing countries: A strategy. *International Journal of Construction Management*, 8, 87–101.

Choudhry, R.M. & Masood, R., 2011. Assessment of multi-level of safety climates of working groups to drive perceptual unification. In *CIB W99 International Conference on Prevention: Means to the End of Injuries, Illnesses, and Fatalities, August 24-26*. Washington D.C., 22–35. Available at: http://goo.gl/J4jtWr

Enshassi, A., Mohamed, S. & Abushaban, S., 2009. Factors affecting the performance of construction projects in the Gaza strip. *Journal of Civil Engineering and Management*, 15(3), 269–280.

Farooqui, R.U., Ahmed, S.M. & Lodi, S.H., 2008. Assessment of Pakistani construction industry – current performance and the way forward. *Journal for the Advancement of Performance Information and Value*, 1(1), 51–72.

Farooqui, R.U., Ahmed, S.M. & Panthi, K., 2007. Developing safety culture in Pakistan construction industry-An assessment of perceptions and practices among construction

contractors. In *4th International Conference on Construction in the 21 st Century (CITC-IV), July 11 -13*. Gold Coast, Australia, 420–437. Available at: http://goo.gl/k4RWra

Flin, R., Mearns, K., O'Connor, P. & Bryden, R., 2000. Measuring safety climate: Identifying the common features. *Safety Science*, 34, 177–192.

Holt, G.D., 1997. Construction research questionnaires and attitude measurement: Relative index or mean? *Journal of Construction Procurement*, 3(2), 88–96.

Hon, C.K.H., Chan, A.P.C. & Yam, M.C.H., 2013. Determining safety climate factors in the repair, maintenance, minor alteration, and addition sector of Hong Kong. *Journal of Construction Engineering and Management*, 139(5), 519–528.

Hossain, M.A., Hossain, M.M., Tarannum, S. & Chowdhury, T.H., 2015. Factors affecting OHS practices in private universities: An empirical study from Bangladesh. *Safety Science*, 72, 371-378.

HSE, 1997. *Health and Safety Climate Survey Tool - Process Guidelines "Health and Safety Executive"*, UK. Available at: http://www.hsl.gov.uk/products/safety-climate-tool

Huang, X. & Hinze, J., 2006. Owner's role in construction safety. *Journal of Construction Engineering and Management*, 132(2), 164–173.

Kheni, N.A., Dainty, A.R. & Gibb, A., 2008. Health and safety management in developing countries: A study of construction SMEs in Ghana. *Construction Management and Economics*, 26(11), 1159-1169.

Koehn, E.E., Kothari, R.K. & Pan, C.S., 1995. Safety in developing countries: Professional and bureaucratic problems. *Journal of Construction Engineering and Management*, 121(3), 261-265.

Kruskal, W.H. & Wallis, W.A., 1952. Use of ranks in one-criterion variance analysis. *Journal of the American Statistical Association*, 47(260), 583–621.

Kulchartchai, O. & Hadikusumo, B.H.W., 2010. Exploratory study of obstacles in safety culture development in the construction industry: A grounded theory approach. *Journal of Construction in Developing Countries*, 15(1), 45–66.

Larcher, P. & Sohail, M., 1999. *Review of Safety in Construction and Operation for the WS&S Sector, Part I - Task No 166*, London. Available at: http://goo.gl/cSCDW1

Le, Y., Shan, M. & Chan, A.P.C., 2014. Overview of corruption research in construction. *Journal of Management in Engineering*, 30(4), 1–7.

Lodi, S.H., Farooqui, R.U. & Ahmed, S.M., 2008. *Development of a strategic model for improvement of construction project management education, research, and practice in Pakistan*, 3rd Annual Report. Washington. Available at: http://goo.gl/7lxZQC

López-Alonso, M., Ibarrondo-Dávila, M.P., Rubio-Gámez, M.C. & Munoz, T.G., 2013. The impact of health and safety investment on construction company costs. *Safety science*, 60, 151–159.

Mearns, K., Whitaker, S.M. & Flin, R., 2003. Safety climate, safety management practice and safety performance in offshore environments. *Safety Science*, 41, 641–680.

Mohamed, S., Ali, T.H. & Tam, W.Y.V., 2009. National culture and safe work behaviour of construction workers in Pakistan. *Safety Science*, 47(1), 29-35.

Mohamed, S., 2002. Safety climate in construction site environments. *Journal of Construction Engineering and Management*, 128(5), 375–384.

Nandakumar, S., 2007. *Benchmarking studies on safety management in construction industries*. MS dissertation, Anna University, Chennai, India. Available at: http://goo.gl/lpn1Vb

Oppenheim, A.N., 1992. *Questionnaire design, interviewing and attitude measurement*, London: Bloomsbury Publishing.

OSHA, 2014. *Occupational Safety & Health Administration Regulations (Standards - 29 CFR)*, USA. Available at: https://goo.gl/W9pi5z

OSHC, 2015. *Occupational Safety and Health Statistics Bulletin - Labour Department.* Hong Kong. Available at: http://goo.gl/WIMhBP

PBS, 2013. *Pakistan Bureau of Statistics - Labour Force Statistics (2012-2013)*, Islamabad. Available at: http://goo.gl/2A4cBG

PEC, 2014. *Pakistan Engineering Council "Categories of Contractors,"* Islamabad, Pakistan. Available at: http://pec.org.pk/fee.aspx

Poon, S.W., Tang, S.L. & Wong, F.K.W., 2008. Financial costs of construction accidents and optimum safety investment. *Chapter-8 in 'Management and Economics of Construction Safety in Hong Kong',* Hong Kong University Press.

Priyadarshani, K., Karunasena, G. & Jayasuriya, S., 2013. Construction safety assessment framework for developing countries: A case study of Sri Lanka. *Journal of Construction in Developing Countries*, 18(1), 33-51.

Raheem, A.A., Hinze, J.W., Azhar, S., Choudhry, R.M., and Riaz, Z., 2011. Comparative analysis of construction safety in Asian developing countries," In *6th International Conference on Construction in 21st Century (CITC-VI) "Construction Challenges in New Decade,"* Kuala Lumpur, 623–630. Available at: http://goo.gl/MgVXsP

Royston, J.P., 1982. An extension of Shapiro and Wilk's W test for normality to large samples. *Applied Statistics*, 31(2), 115–124.

Shash, A.A. & Abdul-Hadi, N.H., 1993. The effect of contractor size on mark-up size decision in Saudi Arabia. *Construction Management and Economics*, 11(6), 421–429.

Spector, P.E., 1994. Using self-report questionnaires in OB research: A comment on the use of a controversial method. *Journal of Organizational Behavior*, 15(5), 385–392.

Suazo, G.A.R. & Jeselskis, E.J., 1993. Comparison of construction safety codes in United States and Honduras. *Journal of Construction Engineering and Management*, 119(3), 560–572.

Wu, T.C., Chen, C.H. & Li, C.C., 2008. A correlation among safety leadership, safety climate and safety performance. *Journal of Loss Prevention in the Process Industries*, 21(3), 307–318.

Yi, W. & Chan, A.P.C., 2014. Critical review of labor productivity research in construction journals. *Journal of Management in Engineering*, 30(2), 214–225.

Zahoor, H. & Choudhry, R.M., 2012. The most neglected construction safety practices in Rawalpindi/Islamabad. In *CIB W099 International Conference on Modeling and Building Health and Safety, September 10-11*. Singapore, 312–322. Available at: http://goo.gl/xhT0Dm

Zohar, D., 2000. A group-level model of safety climate: testing the effect of group climate on microaccidents in manufacturing jobs. *Journal of Applied Psychology*, 85(4), 587–596.

TABLES

Table 1. Frequency of respondents and their companies based on the contractors' categories

Categories of PEC*	Financial Limit (*Pakistani Rupees in Million*)	Respondents' Frequency (%)	No. of Companies
C-A	No financial limit	83 (42.56)	14
C-B	Upto 3000	24 (12.31)	8
C-1	Upto 1800	30 (15.38)	5
C-2	Upto 800	20 (10.26)	6
C-3	Upto 400	11 (5.64)	7
C-4	Upto 150	15 (7.70)	4
C-5	Upto 50	12 (6.15)	3
C-6	Upto 20	-	-
	Total	195 (100)	47

*Source**: Pakistan Engineering Council (PEC 2014)

Note: US Dollar 1.00 = Pakistan Rupees 104.00 (*Source*: http://goo.gl/X6rhBH)

Table 2. Reliability statistics

Case processing summary					
		N	%	Cronbach's alpha	0.914
Cases	Valid	195	100.0		
	Excluded[a]	0	.0		
	Total	195	100.0	Number of items	60

a. List wise deletion based on all variables in the procedure

Table 3. Kruskal Wallis test[a,b] and ranking of all OSH factors

OSH factors	Sig.	PIs	Ranking[c]
Management commitment to OSH	0.033	0.6253	7
Worker's involvement	0.057	0.5352	10
Safety in the contract documents	0.218	0.5237	12
Safety rules/procedures and policies	0.013	0.5798	8
Accident reporting and investigation	0.123	0.6368	5
Provision of OSH training	0.023	0.5230	13
Safety meetings	0.091	0.5254	11
Incentives/disincentives for the workers	0.081	0.5598	9
Use of 'Personnel Protective Equipment'	0.060	0.6274	6
Housekeeping, storage and sanitation	0.260	0.6830	3
Quality of scaffolding and ladders	0.542	0.6493	4
Precautions during excavation and shoring	0.795	0.6980	2
Hoists and crane operations	0.673	0.7816	1

[a]Kruskal Wallis test.

[b]Grouping variable: stakeholders (client, consultant and contractor).

[c]Ranking is based on the overall PI value of each OSH factor (Zahoor & Choudhry 2012), where 1 shows good and 13 shows poor performance.

Table 4. Kruskal Wallis test[a,b] of selected OSH practices

OSH practices[c]	Sig.
Management commitment to OSH (9)	
OSH is given priority over productivity by the higher management	0.012
There is no work pressure on workers and safety is given priority over time	0.012
Regular OSH inspections are conducted by the higher management and safety officials	0.115
Management motivates to work safely	0.168
Company really cares about the OSH of their workers	0.322
Field Engineer, supervisor and safety officer encourage reporting of hazards	0.416
Management acts quickly to correct OSH problems	0.289
Good communication is established between management and workers	0.427
Sufficient manpower and equipment are always made available by the management, to do the job safely	0.222
Safety rules/procedures and policies (6)	
Company has developed its OSH policy in the light of OSHA	0.641
Site emergency plan is prepared and job hazard analysis is done for each task	0.146
Safety audits are conducted regularly	0.030
First aid facility is made available on site	0.876
Workers are medically examined regularly	0.042
Insurance coverage is provided to the workers	0.002
Provision of OSH training (6)	

OSH training for new workers is compulsory	0.16
OSH refresher training sessions are periodically conducted for all workers	0.003
OSH training is provided to the employees of subcontractors also	0.564
Adequate job-specific OSH training is given to workers before start of a job	0.066
Organizational charts are displayed on work-site showing the names, positions and responsibilities for safety compliance	0.020
Safety posters and sign boards are used at important places for workers' awareness, both in English and Urdu languages	0.505

[a]Kruskal Wallis test.

[b]Grouping variable: stakeholders (client, consultant and contractor).

[c]These 21 OSH practices are out of a total of 60 practices, already used for calculating the mean and percentage values for the capital city of Islamabad (Zahoor & Choudhry 2012).

Table 5. PI values of selected OSH practices for key stakeholders

OSH practices[a]	PI values of key stakeholders		
	Client	Consultant	Contractor
Management commitment to OSH			
OSH is given priority over productivity by the higher management	0.5692	0.4615	0.5862
There is no work pressure on workers and safety is given priority over time.	0.5385	0.4231	0.5494
Safety rules/procedures and policies			
Safety audits are conducted regularly	0.5385	0.4154	0.5425
Workers are medically examined regularly	0.6051	0.4692	0.5885
Insurance coverage is provided to the workers	0.5641	0.4154	0.5908
Provision of OSH training			
OSH refresher training sessions are periodically conducted for all workers	0.4462	0.3385	0.5057
Organizational charts are displayed on work-site showing the names, positions and responsibilities for safety compliance	0.4872	0.4385	0.5655

[a]These seven OSH practices are out of a total of 60 practices, already used for calculating the mean and percentage values for the capital city of Islamabad (Zahoor & Choudhry 2012).

Table 6. Allocation of budget for OSH compliance on construction projects

Safety budget (% of project cost)	Respondents frequency	Respondents percentage
4 - 6 %	-	0
2 - 4 %	3	1.54
1 – 2 %	9	4.61
Less than 1 %	63	32.3
No budget	120	61.54
Total	195	100

Table 7. Frequency of toolbox talks

Frequency of toolbox talks	Respondents frequency	Respondents percentage
Daily	3	1.54
Twice a week	9	4.6
Weekly	28	14.38
Fortnightly	65	33.33
Never held	90	46.15
Total	195	100

Table 8. Post-accident safety response mechanism

Post-accident safety response mechanism on work-site	Respondents frequency	Respondents percentage
Only the project manager decides the response mechanism	59	30.25
Only the accident is reported	67	34.36
Preventive action is taken to avoid occurrence in future	46	23.6
Immediate organizational level action is taken	23	11.8
Total	195	100

Table 9. Responsibility for safety of employees

Responsibility for safety of employees	Respondents frequency	Respondents percentage
Safety officer	54	27.7
Project director (office)	32	16.41
Construction manager (site)	37	18.97
Field supervisor	10	5.13
Employees themselves	62	31.8
Total	195	100