7th International Civil Engineering Congress
(ICEC-2015)
“Sustainable Development through Advancements in Civil Engineering”
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CONGRESS PROCEEDINGS

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Congress Introduction

Pakistan is among the developing countries which unfortunately face challenges like insufficient infrastructure, energy crisis, pollution, traffic congestion among others. Construction projects initiated serve as the catalyst to the economic prosperity of any country by providing jobs and infrastructure to fulfill basic needs of shelter health and education. Like many other industries in Pakistan, this sector has also been lacking the use of state-of-the-art technologies. This situation has led to poor quality construction and increased maintenance costs. This conference provides an opportunity to the professionals, and academicians of civil engineering to share their knowledge and experience. It is expected that such collaboration will lead to improvement in the current industry practices leading to sustained development for the community.
Congress Partners

ICEC – 2015 is jointly organized by two prominent engineering institutions in Pakistan; Institute of Engineers Pakistan and NED University of Engineering & Technology.

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The Institution of Engineers Pakistan (IEP) was established in 1948. It is the premier national body of engineers working for the advancement of the Engineering Profession. It has headquarters at Lahore and centers in all major cities of Pakistan as well as in Riyadh, Saudi Arabia & Bahrain. IEP has signed technical collaboration agreements with more than forty professional Engineering Organizations across the globe. IEP is also the member of six international / regional engineering bodies and has the honor to represent Pakistan at these forums. IEP Karachi Centre is the biggest center of IEP. IEP Karachi Centre has been organizing International Civil Engineering Congresses since 2000. Since then it has organized 5 more, the last being in 2013. Seventh International Civil Engineering Congress will be a 2 days event, spread over an inaugural and six technical sessions on the 12 and 13 June 2015.

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NED University is one of the oldest engineering institutions in Pakistan. It offers Bachelors, Masters and Doctoral degree programs. The programs are aimed at preparing students to shoulder their professional responsibilities and enable them to contribute in research and development in related fields. Various seminars and conferences are held every year which not only provide practical exposure to students but also a platform for academia-industry collaboration.
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Construction Safety Research in Pakistan: A Review and Future Research Direction

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Abstract
Comprehensive review of construction safety research is presented in this paper, aiming at summarizing the completed research work in Pakistan. It includes eleven journal papers, two dissertations and thirty two conference papers. Construction accidents are mostly caused by; fall from height, followed by electrocution. Safety non-compliance is attributed to; non-existence of a regulatory authority, delusion that investing in safety will increase the project cost, workers’ unawareness, and unrealistic deadlines. Though Pakistan Engineering Council (PEC) is conducting safety awareness workshops for engineers and supervisors, no training is planned for construction workers. Few private institutes are also providing safety training but only on commercial basis. The deteriorating safety situation can be enhanced by ensuring management’s commitment and employees’ involvement, effective supervision and communication, safety education and training, and accident reporting mechanism. It has also been recommended to establish occupational health and safety regulatory authority, redefine and enforce safety laws, and launch media campaigns to create awareness among workers. PEC is suggested to enhance the safety performance by; allocating the safety budget and responsibilities in contract documents, incorporating safety credit points in contractor licensing process, and maintaining accident statistics. Potential research areas are also identified to kindle the construction safety research in Pakistan.

Keywords
Safety management system, Safety climate, Safety practices, Review, Pakistan.

1. Introduction
The construction industry is suffering from higher fatality and injury rates because of its unique nature, unpredictable site conditions, diversified human behaviour, and unsafe procedures (Ahmed et al. 2000). The developed countries are implementing various safety, health and environmental management systems to minimize these fatalities (Chan et al. 2008). Various safety schemes have also been introduced which resulted into a consistent decrease in the accident rate during the last 20 years (Choudhry et al. 2008).
Contrary to this, in the developing countries like Pakistan, stakeholders’ emphasis is primarily on improving the construction quality, and reducing cost and time, whereas safety is least on their agenda. Safety regulatory authority is almost ineffective and contractors are reluctant to share the actual record of injuries and fatalities (Faroqui et al. 2007; Ali, 2006). Primary construction regulatory body i.e. Pakistan Engineering Council (PEC) has yet to lay down safety regulations to be followed in the industry (Faroqui et al. 2007). According to Farooqui et al. (2008b) most clients demand maximum speed and good quality of work at the lowest possible cost, whereas no budget is specified for safety compliance. Small construction firms do not have any safety policy so unsafe conditions exist on their work sites and labourers are exposed to hazardous conditions, however, most of the large firms, registered with PEC in category C-A (category of the contractor having no financial limit), do have a safety policy, provide safety training to their workers, and maintain safety personnel on their worksites (Raheem and Hinze, 2013b; Farooqui et al. 2008b).

According to the annual reports of Pakistan Bureau of Statistics, 7.4% (4.424 Million) of the total labour force (59.79 Millions) are associated with the construction industry (PBS, 2012-2013; 2010-2011). Consistent increase has been observed in the injuries/accidents from 14.55% in 2006 to 15.24% in 2012 in the construction industry (Table 1). Hence, it has emerged to be the 2nd most injury prone industry after the agriculture. Conversely, increase in its employment rate is relatively lower than other industries. According to Table 2, employment rate has gradually increased from 6.56% in 2006 to 7.4% in 2012. It can therefore be inferred that construction industry is employing only 7.4% of total labour force whereas its injury rate is alarmingly high (15.24% of total labour force).

**Table 1: Occupational injuries/diseases – Percentage distribution by major industries in Pakistan**

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<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Agriculture, Forestry, Fishing</td>
<td>40.94</td>
<td>46.84</td>
<td>50.43</td>
<td>50.2</td>
<td>49.8</td>
<td>49.1</td>
<td>1</td>
</tr>
<tr>
<td>Mining/Quarrying</td>
<td>0.29</td>
<td>0.09</td>
<td>0.33</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>15.21</td>
<td>12.72</td>
<td>13.96</td>
<td>12.8</td>
<td>15.8</td>
<td>13.3</td>
<td>3</td>
</tr>
<tr>
<td>Electricity, gas and water</td>
<td>0.87</td>
<td>0.51</td>
<td>0.71</td>
<td>0.4</td>
<td>0.2</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>14.55</td>
<td>14.93</td>
<td>14.54</td>
<td>14.3</td>
<td>13</td>
<td>15.2</td>
<td>2</td>
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<tr>
<td>Retail Trade, Restaurants and Hotels</td>
<td>9.26</td>
<td>7.96</td>
<td>7.54</td>
<td>10.6</td>
<td>10.3</td>
<td>9.2</td>
<td>4</td>
</tr>
<tr>
<td>Transport/Communication</td>
<td>7.98</td>
<td>8.02</td>
<td>8.14</td>
<td>8</td>
<td>7.1</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>Community/Social Services</td>
<td>10.56</td>
<td>8.39</td>
<td>4.33</td>
<td>3.5</td>
<td>3.3</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>Other Industries</td>
<td>0.34</td>
<td>0.54</td>
<td>0.02</td>
<td>0.1</td>
<td>0.3</td>
<td>0.1</td>
<td></td>
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</table>

**Table 2: Percentage distribution of employed persons by major industries in Pakistan**

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</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Forestry, Fishing</td>
<td>43.61</td>
<td>46.84</td>
<td>44.91</td>
<td>45</td>
<td>45.1</td>
<td>43.7</td>
<td>1</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>13.54</td>
<td>12.72</td>
<td>13.02</td>
<td>13.2</td>
<td>13.7</td>
<td>14.1</td>
<td>3</td>
</tr>
<tr>
<td>Construction</td>
<td>6.56</td>
<td>14.93</td>
<td>6.62</td>
<td>6.7</td>
<td>7</td>
<td>7.4</td>
<td>5</td>
</tr>
<tr>
<td>Retail Trade, Restaurants and Hotels</td>
<td>14.42</td>
<td>7.96</td>
<td>15.16</td>
<td>16.3</td>
<td>16.2</td>
<td>14.4</td>
<td>2</td>
</tr>
<tr>
<td>Transport/Communication</td>
<td>5.39</td>
<td>8.02</td>
<td>5.23</td>
<td>5.2</td>
<td>5.1</td>
<td>5.5</td>
<td>6</td>
</tr>
<tr>
<td>Community/Social Services</td>
<td>14.41</td>
<td>8.39</td>
<td>2.58</td>
<td>11.2</td>
<td>10.8</td>
<td>13.3</td>
<td>4</td>
</tr>
<tr>
<td>Other industries</td>
<td>2.07</td>
<td>1.14</td>
<td>12.48</td>
<td>2.4</td>
<td>2.1</td>
<td>1.6</td>
<td>7</td>
</tr>
</tbody>
</table>

**2. Objectives**

This paper is aimed at reviewing the safety research carried out in the construction industry of Pakistan, with following objectives:

a. Carry out a comprehensive review of construction safety research conducted in Pakistan.

b. Examine the safety regulations and their enforcement in Pakistan.

c. Find the gap for future research in the field of construction safety in Pakistan.


3. Research Methodology

A systematic literature review is conducted in three stages for investigating the research work carried out in the field of construction safety in Pakistan. In stage-1, a comprehensive desktop search was conducted with the search keywords; safety, safety climate, safety practices, construction and Pakistan. The databases such as Scopus, EBSCO, Science Direct, Google, Google scholar and Web of science were searched to find the related journal papers. The search result indicated that only fourteen journal papers have been published related to the construction safety in Pakistan. In the second stage, proceedings of International conferences were searched using the above mentioned search engines. Using the snow ball technique, references given at the end of each paper were also checked so as to find the related papers. In stage-3, google scholar profiles of Pakistani researchers, who are actively involved in construction safety research, were explored. As a result, all related papers had either been downloaded (if available) or obtained from the authors via personal email requests. Hence, a total of 14 journal papers, two dissertations (one PhD and the other M. Phil), and 32 international conference papers from 12 conference proceedings had been selected for review.

4. Overview of Construction Safety Research in Pakistan

4.1 Categories of the Research Papers

Out of the fourteen shortlisted journal papers related to safety in Pakistan, 3 were related to roads, 1 for Engro-food industry and 10 were related to the construction industry (8 International and 2 Pakistani journals). Topics covered in these journal papers include safety performance, safety culture, safety climate, national culture, safety policy formulation and enforcement, use of wireless technology (Riaz et al. 2014) and Building Information Modelling. Only four of these journal papers have been published in the top peer-reviewed journals. In most of the papers, basic statistical techniques had been used to analyze the data collected through questionnaire survey and interviews; however Mohamed et al. (2009) have also used factor analysis. Four scholars including Dr. Rafiq M. Choudhry, Dr. Rizwan U. Farooqui, Engineer Rehan Masood and Adeeba A. Raheem are actively involved in safety research in Pakistan. Out of the thirty two conference papers, twenty two are written by these researchers. Most of their papers are related to safety policies, safety culture, safety climate, safety practices and safety management systems.

4.2 Questionnaires being adopted by the Researchers

Questionnaire designed by McDonald and Hrymak (2001) for the Irish construction industry, Mohamed (2002) for the Australian construction industry, and Choudhry et al. (2008 and 2009) for the Hong Kong construction industry had been used by the researchers to explore the construction safety performance in Pakistan. Mohamed and Ali (2005) and Mohamed et al. (2009) have also designed a questionnaire to analyze the influence of national culture on safety behaviour. Similarly, 70 statements questionnaire under 10 groups by Ahmed (2013) and 31 statements safety climate questionnaire by Choudhry et al. (2009) were also adopted to assess the construction safety climate in Pakistan (Choudhry and Masood, 2011).

4.3 Current Safety Practices

Though technological advancement is the need of hour, it has adversely affected the construction safety especially in the developing countries, where emphasis had always been on the productivity than the safety (Farooqui et al. 2008a; Masood et al. 2014). Injury/fatality statistics of construction projects are yet to be maintained at the industry or national level (Khan, 2013b, Raheem et al. 2012), so the lagging indicators of accident statistics cannot be used to analyze the safety performance. Raheem and Hinze (2012 and 2013b) have highlighted that most of the construction companies do not update their safety manuals. Similarly,
safety policies are made only for the documentation purposes (Jafri, 2012; Masood et al. 2012c). Mohamed and Ali (2005) and Qazi et al. (2006) have analyzed the effect of awareness and beliefs, physical environment and supportive environment on safety culture, and highlighted the neglected safety practices, as; poor quality scaffolding without guard rails, defective ladders not tied properly, working on roof without edge protection, temporary laid power lines and manual deep excavation without bracing. Safety training has been identified as the most neglected aspect (Haider et al. 2013; Zahoor and Choudhry, 2012). Managers and the workforce have varied opinion about safety compliance on their work sites (Masood et al. 2012b).

4.3.1 Causes of accidents
Major causes of construction accidents, in descending order, are; fall from height, electrocution, caught in between the machinery and struck by falling objects (Hassan, 2012; Nawaz et al. 2013). Higher unemployment ratio and more number of unskilled workers are also the main causes of accidents (Jafri et al. 2012). Few indirect cost effects have also been identified like cost of employing additional manpower, lost work hours of fellow crew members due to temporary halts and lowering of morale (Farooqui et al. 2008a).

4.3.2 Reasons for safety non-compliance
Non-compliance to safety regulations is attributed to; non-existence of any regulatory authority, greed for making more profit, delusion that investing in safety will increase the project cost, workers’ non-cooperation and ignorance for their rights, poor safety management techniques, political influence, pervasive corruption, meeting unrealistic deadlines, extended working hours, less wages, no maintenance and inspection schedule, no safety training, no requirement of safety certification for the workers, shortage of safety personnel, and giving least value to human lives (Farooqui, 2012; Farooqui et al. 2008a; Raheem et al. 2011; Saqib et al. 2010; Choudhry et al. 2012 and 2006).

4.3.3 Recommendations by the researchers
The significant safety climate factors have been identified as management’s commitment and employees’ involvement (Choudhry and Masood, 2011). Mohamed et al. (2009) have concluded that under collectivist, feminist and higher uncertainty avoidance environment, safety performance can be improved. It has been emphasized to bring a cultural change and a shift in the mind set of upper echelons in the government to improve the deteriorating safety situation (Ahmed, 2013). Stakeholders need to be educated that accident not only causes an injury but also results in time delay, morale lowering, indirect labour replacement cost, equipment repair cost, and most importantly brings bad name to the company (Hinze, 2000). The researchers have also recommended to enhance the safety performance by; redefining and enforcing safety rules and regulations, establishing health and safety regulatory authority, appointing safety inspectors, allocating sufficient budget for safety training and education, and developing an effective communication and accident reporting mechanism (Memon et al. 2013; Nawaz et al. 2013; Hassan, 2012).

Choudhry et al. (2008) have suggested that safety incentives, green card scheme and safety management system in Hong Kong are equally applicable to Pakistan and their implementation can bring positive change in the working environment. They have also suggested that Directorate of Workers Education (DWE) should take a leading role towards enhancing safety standards in all the industries. PEC is recommended to; ensure safety through contractual obligations, allocate safety budget in contract documents, incorporate ‘safety credit points’ in the contractor license renewal process, employ safety staff, and maintain accident statistics (Raheem and Hinze, 2013a; Zahoor and Choudhry, 2012). Two (2) credit hours Occupational Health and Safety (OH&S) course has also been recommended for civil, architect and town planning students, so as to strengthen the safety awareness among the key stakeholders (Masood et al. 2012a).

5. Safety Enforcement and Training Institutes
At the Federal government level, DWE working under the Ministry of Capital Administration & Development is primarily responsible to create awareness among workers for their rights and to educate
them about their social and economic problems including OH&S training; however its performance is not satisfactory. In the province of Punjab, the department of Labour & Human Resource has established an ancillary body ‘The Centre for Improvement of Working Conditions & Environment’ (CIWCE) at Lahore, which is providing professional services in the fields of OH&S. Few private institutes are also providing OH&S training but on commercial basis, including; Occupational Safety and Loss Prevention (OSALP), Occupational Training Institute (OTI), and Vivid Institute of Occupational Safety and Health (VIOSH).

PEC is also conducting safety awareness workshops and compulsory ‘Continuing Professional Development’ (CPD) short courses but these training sessions are only for engineers and supervisors, whereas no training is organized for construction workers (Khan et al. 2013a). PEC has incorporated following OH&S clauses in its contract documents but these are mostly not enforced due to the absence of a regulatory authority.

a. Safety, security and protection of the environment: It is clause 19.1 of part-I (General conditions of contract) of PEC standard form of bidding documents (PEC, 2007, p.90).

b. Safety precautions: It is clause 19.3 of part-II (Particular conditions of contract) of PEC standard form of bidding documents (PEC, 2007, p.152).

6. Challenges for the Safety Researchers in Pakistan

6.1 Scarcity of Construction Safety Research

Research in the field of construction safety in Pakistan remained almost neglected, as the key stakeholders had been focusing on productivity only. Accident statistics have not been maintained at the industry level so it has proven to be the major obstacle in the data collection. Only a few researchers have worked in this area using the leading safety indicators. They have mostly used descriptive statistics for the data analysis. Moreover, sample sizes are also not quite reliable. Likewise, Structural Equation Modeling and Social Network Analysis have not been used for the data analysis and validation. Hence, very few researches had been published in the peer reviewed journals.

6.2 Future Research Directions

Detailed study may be carried out to identify the safety climate factors affecting the safety performance in the Pakistani construction industry using the exploratory factor analysis. Causal relationship among various safety climate factors using the structural equation modeling (confirmatory factor analysis) needs to be examined. A study may be conducted to examine the safety practices being practiced in the tall buildings construction as they are suffering from higher accident rates (Zahoor et al. 2015). Research may also be instigated to assess the applicability of successful construction safety management practices of the developed countries in Pakistan. Unsafe behavior of the workers, which is intrinsically linked to the workplace accidents, needs to be explored to ascertain the root causes of accidents and study the varied behaviour of different tradesmen. Likewise, applicability of innovative (information and communication) technologies to effectively monitor the safety performance on construction sites needs to be explored. There is also a need to compare the cost of accidents with the investment needed for safety compliance. Contractual obligations of various construction departments may also be examined. Standardized safety rules and regulations are also required to be established for the construction industry of Pakistan.

7. Conclusions

Construction safety research in Pakistan is in its embryonic stage. Very few researches have been published in the journals; however many have been published in the conference proceedings which are
mostly not accessible online. This paper is an attempt towards summarizing the completed research work and identifying the research gap for further consideration by the researchers.

In Pakistan, construction companies are reluctant to share the accident statistics; however fatalities are mostly reported due to the fear of litigation (Choudhry et al. 2008; Mohamed, 2002). Higher unemployment ratio, unawareness and illiteracy rate force the workers to work under unfavorable site conditions. Fall from height is key cause of construction accidents (Choudhry et al. 2014). PEC Contractors’ selection criterion is only based on financial strength and not the safety performance. Though PEC has incorporated safety clauses in its contract documents, they are not enforced due to the absence of a regulatory authority. PEC is also conducting CPD webinars and seminars to create awareness among its graduate members; however no attention is paid towards workers’ training. PEC is recommended to: launch safety awareness campaigns; establish OH&S regulatory authority; revise the contracting and bidding documents for provision of safety budget by the clients; incorporate safety credit points in the contractors’ selection criteria; and establish an effective accident reporting and investigation mechanism. Future research directions have also been recommended for actuating the research process in the field of construction safety in Pakistan.

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