AN ESTIMATE OF FATAL ACCIDENTS IN INDIAN CONSTRUCTION

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The construction sector is very hazardous across the globe. However, in some countries there is an absence of standard recording and notifications system for construction accidents while in countries such as India, the systems exist but their implementation is an issue. In both cases, statistics on construction accidents are either unavailable or highly underreported and this leads to a situation where due attention to safety is not paid. This paper attempts to estimate fatal accidents of construction sector for all states in India. These estimates are based on reliable information derived for the construction sector of National Capital Territory (NCT) Delhi region using different sources. This study further projects the fatal accidents for all states based on working population data obtained from Census. The quantum of construction work in all states are differentiated based on their data on cement consumption using linear inter and extrapolation methods. In line with this estimate the minimum number of people that would have died annually in Indian construction sector from 2008 to 2012 was 11,614. The estimates presented here would help in drawing attention of all stakeholders to take remedial measures.

Keywords: estimating, accident, injury, safety, India

INTRODUCTION

Safety is a basic physical and psychological need of human beings. Every day some 950 people die and over 720,000 workers get hurt because of occupational accidents. Annually, over 48,000 workers die because of occupational accidents in India and there are almost 37 million occupational accidents which causes at least 4 days' absences from work (Hämäläinen 2010). In terms of economics, the International Labour Organization (ILO) has estimated that the total costs of occupational accidents and work related diseases are 4% of the gross national product (GNP). The total GNP of the world was approximately 75,592,941 million USD in 2013 (World Bank 2013) which means that worldwide the annual cost of work-related injuries and diseases is approximately 3,023,718 million USD (0.04x75, 592,941).

The construction sector is the second largest employer in India; however, according to Hämäläinen et al. (2010), accident statistics of the Indian construction sector are not properly and regularly published. Therefore, they are not easily available. However, it is expected that many fatal and non-fatal accidents would be happening in Indian construction due to its characteristics such as dynamic nature and involvement of

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many stakeholders including migrated labours in a project, and a less controlled environment. Whatever data is available our research shows that they are underreported (Patel 2015). Although, there is a system prescribed for compiling and recording these statistics the implementation at every places in country is not done in full seriousness. According to Zhou et al. (2015), this is one of the reasons for not conducting sufficient research on construction safety in India. Therefore, this study sets the following objectives: (1) to study the existing global and national accidents statistics of construction sector; and (2) to estimate the number of fatal construction accidents in India.

In the following sections, the review of existing literature on the subject and thereafter research method are presented to achieve the objectives. The different methods utilized to obtain the realistic estimate have been explained and thereafter the discussions and finally the conclusions are presented.

LITERATURE REVIEW

Safety performance is generally measured by reactive (after the event) and proactive indicators (Hinze *et al.,* 2013). The choice of safety performance measures or indicators relies upon the purpose of measurement. The reactive measures are most suitable to be used for the evaluation of past safety efforts or for the purpose of comparison; while the proactive measures can be used to indicate whether the current systems or efforts are working properly (Hinze and Godfrey 2003; Holt 2005). According to Hale (2009), validity, reliability, sensibility, representativeness, openness to bias, and cost effectiveness are criteria to select good safety performance indicators. Hinze (2013) also suggests safety regulatory agencies, insurance companies and other companies to continue using the lagging indicators. However, sometimes, even reputed companies are not willing to share accident and injury data for their projects. The unavailability of accident statistics is a hurdle in conducting research on construction safety in India (Patel 2015).

In India, the estimated numbers of persons employed in Construction Industry are 53.45 million for year 2012 (Indian Labour Statistics 2012 and 2013) and there is a shortage of trained man power. On account of natural attrition and the need of skills of contemporary trades, construction industry still needs infusion of at least six million persons per year (CIDC report 2007). This clearly shows the importance and value of workers in construction industry and thus an inspiration to review the existing accident statistics of Indian construction sector.

In general, the tendency of constructors is to keep away from reporting accidents to the relevant authorities. Therefore, it becomes difficult to study the trend of accidents and review the safety performance of the construction sector at state and national level. As a result, it also becomes difficult to compare the safety performance of India with other countries. Nonetheless, Indian Labour Statistics (2012-2013) consists of the records of fatal and non-fatal accidents of mines, factories, railways. However, it does not include the estimates of fatal and non-fatal construction accidents. Therefore, there is a pressing need to estimate the fatal and non-fatal accidents in Indian construction sector.

FRAMEWORK OF THE STUDY

Some researchers (Hämäläinen 2010, Nelson et al. 2005, Leigh et al. 1997) attempted to estimate the occupational accident and disease at global and national level. ILO (1996) emphasizes the estimation of occupation accidents and diseases and

has prepared a code to assist the countries to set the system to record the same. So far existing literature lacks the standard research methodology to estimate accidents in construction sector. Therefore, a framework of the study has been developed and discussed briefly in the following sections to estimate fatal accidents in the Indian construction sector.

Identifying and evaluating the list of sources for accident records

A number of plausible sources were consulted for the accident data. These sources were identified based on past researches and interaction with experts and professionals. While some of them were part of direct approach some of them were indirect. A total of 10 different sources were employed for the data collection. These are briefly explained below under the data collection section.

Data collection

As pointed out above, the data were collected and complied from the following 10 sources.

25. National and International Journals
26. Websites of Government Departments and Private Bodies
27. Non-government organizations (NGO)
28. First Information Reports (FIRs) in Police Stations
29. Medical Legal Registers (MLR) at Public Health Centres and Hospitals
30. Insurance Companies
31. Right to Information (RTI) Act, 2005: The Right to Information (RTI) Act 2005 mandates timely response to any Indian citizen requesting for information from a government agency
32. Rajya Sabha: The Rajya Sabha or Council of States is the upper house of the Parliament of India
33. Leading newspapers
34. Online search engines

Review of the collected accident data

There are no sound basis on which the accident statistics in Indian construction are reported in International and National Journals. Similarly there are limitations with the available Government (such as the concerned departments, ministries, and Rajya-Sabha) and NGO records as these records capture the data only for an incident which are reported. Police Stations do not sort and maintain the FIRs based on industry in India. All leading newspapers and online search engines do not cover all accidents. The Right to Information Act 2005 also has the same lacunae as under this Act the available data only need to be shared with general public.

In the global context, reporting of construction accidents to the relevant authorities varies among countries. Member countries of the European Union have mainly two types of system to record their occupational accidents: (1) an insurance-based system, public or private, or (2) legal obligation based system to notify accidents (Hämäläinen 2010). The reporting level is typically quite high - around 100 per cent in the insurance-based system, while the reporting level is only 30 to 50 per cent in reporting based on the legal obligation system. In India, the insurance companies and Medical Legal Register (MLR) do not consist of information regarding cause of accidents and the data is also not sorted industry-wise. In fact, due to lack of effective enforcement, accident data is still widely under reported in India. Even in the global context, there is huge underreporting in accident statistics. The accidents reported to ILO comprise

only 3.9% of the estimated number of accidents that have occurred across the world (Hämäläinen 2010). Leigh et al. (2004) have found that 33% to 69% of all occupational injuries were missing from the injuries reported in the USA. It means that under reporting accident data is the major global issue.

In the absence of a credible source, it was decided to make a beginning by relying on the reports published in prestigious newspapers and complementing it with the Right to Information Act. The data from the Delhi Metro Rail Corporation (DMRC) and Indian express seem more reliable due to their effective accident recording and reporting system. However, the collected accident statistics could not be generalized at national level as it is not able to reflect the full estimate of fatal and non-fatal accidents in Indian construction sector. Therefore, it needs to make a projection based on the reliable base and suitable method to estimate the accident statistics of construction sector at the national level.

Assumption and establishment of a baseline for the estimation

The National Capital Territory (NCT) Delhi has been considered as the baseline for the national accident estimation. The capital of India, New Delhi is within this NCT Delhi. The NCT Delhi covers 1483 Square Kilometre (km) and has a population of about 16.78 million making it the second most populous city and second most populous urban agglomeration in India. Such is the nature of urban expansion in Delhi that its growth has expanded beyond the NCT to incorporate towns in neighbouring states. Since 1991, under the constitution of India, the NCT has been given special status as the National Capital Region (NCR) which includes the neighbouring cities of Gurgaon, Ghaziabad, Noida, Faridabad, Greater Faridabad, Greater Noida, Bahadurgarh, Sonepat, Karnal, Rohtak, Bhiwani, Rewari, Baghpat, Alwar, Bharatpur, Panipat, Meerut and other nearby towns. To manage the urban traffic of this territory, Delhi metro construction project is set up in year 2000 as a project of national importance and is funded partly by Japan International Cooperation Agency. The Delhi metro is the World's thirteenth largest metro system in terms of length and it is expanding its network in the NCR also. The DMRC has good accident recording system as it regularly collects, compiles, and reviews the accidents records of the Delhi metro rail construction projects. In fact, such is the importance of safety in this organisation that they have a separate contract conditions on safety running into about 100 pages. Moreover, in 2010, 19th Commonwealth Games (CWG) was held in the NCT Delhi. Therefore, a large number of construction projects were speedily completed before commencing that mega event in the NCT Delhi.

Arguably, accident statistics collected from the Indian Express newspaper and DMRC New Delhi appear more reliable than the remaining sources discussed earlier. The accident statistics of DMRC collected through the RTI 2005 Act is considered for the estimation due to its greater reliability. All these have led to consider the NCT Delhi as the baseline for the accident estimation for other states of India in this study.

Estimation of fatal accidents in the NCT Delhi

As mentioned earlier, the accident statistics of the NCT Delhi has been estimated based on the Indian Express Newspaper reports and the records obtained through the DMRC under the RTI Act, 2005. Authors have referred all hard copies of the Indian Express newspaper from 2008-2012 and enlisted all of them to avoid their duplication from different sources. The accident report from the Indian Express Newspaper is categorised into three sources: (1) reports pertaining to projects of DMRC in the NCT Delhi (10 fatal); (2) reports pertaining to projects of Commonwealth Games (CWG) in

the NCT Delhi (43 fatal); (3) reports pertaining to other construction projects of the NCT Delhi (176 fatal) as shown in Table 1. In brief, from 2008 to 2012, a minimum of 229 fatal accidents would have occurred in NCT Delhi region alone based on the records of the DMRC and the Indian Express. However, the coverage of construction accidents by the Indian express may not be 100% as the Indian express has only reported a total of 10 fatal accidents in Delhi metro construction project as against the record of DMRC which says that a total of 56 fatal accidents occurred from 2008 to 2012 as shown in Table 1. It is assumed here that DMRC has covered all accidents. In other words, the Indian Express reported only 17.85 % fatal (10 fatal against 56 fatal accidents) accidents in the NCT Delhi during 2008-2012.

Therefore, using the linear interpolation method and rate of underreported accidents (17.85 % for fatal accidents), the data of 229 fatal accidents can be adjusted. Based on this adjustment, it can be safely assumed that 1282 (229÷0.1785) fatal accidents would have occurred in NCT Delhi from 2008 to 2012. In other words, on an average, a minimum of 256 fatal accidents must have happened every year in the NCT Delhi between 2008 and 2012. Post analysis, safety personnel of few leading companies were contacted to comment on the results. On the condition of confidentiality, they agreed that they were not much surprised with this result as they were fairly in line with the statistics they maintain with them.

Table 1: Actual and estimated fatal accident statistics of the NCT Delhi from 2008-2012

Category Actual/ Estimated* Fatal Accidents (numbers)	Fatal Accidents (numbers) reported by The Indian Express	Actual / Estimated * Fatal Accidents (numbers)	Remarks
Reports related to projects of Delhi Metro Rail Corporation (DMRC) in the NCT Delhi	10	56	The underreporting percentage in fatal accidents is derived from the newspaper reported accidents and the actual accidents obtained from the DMRC using the Right to Information Act 2005.
Reports related to projects of Commonwealth Games (CWG) in the NCT Delhi	43	241*	
Accidents reports related to other construction projects of the NCT Delhi	176	985*	
Total of above for the NCT Delhi based on The Indian Express (five years)	229	1282	
Average Annual Value	45	256*	

(*These figures have been estimated based on the underreporting percentage which works out to be (10/56) x 100%=17.85% for fatal accidents.)

Selection of parameters (working population, accident rate and cement consumption) for the estimation

According to Hämäläinen (2010), number of total employment, Gross Domestic Product (GDP), urbanization, number of women, and time series analysis of developed countries could be useful to estimate the occupational accidents and work related diseases. To estimate the global estimate of the occupational accident, Hämäläinen (2010) used the accident rate of each country to its respective economical active population. However, as per the records available with Government agencies, under the BOCW 1996 Act, only 30,603 and 27,248 construction workers have been registered in central sphere across the country for the year 2011-12 and 2012-13

respectively. The figure for the NCT Delhi region as per the records is only 473 and 317 for the year 2011-12 and 2012-13 respectively. Registered workers can avail many financial benefits and perks under welfare scheme of the governments. Less number of registered workers reflects the non-availability of the sound record of the workers associated with construction sector.

The study requires estimating the number of workers employed in construction sector in various states in 2012 as the above statistics fail to reveal the number of workers employed in construction sector. However, working population is available as per record of census 2011 published by Indian labour Statistics (2012). According to the report of Planning Commission of India (2012), the projected share of employment in construction sector for the year 2011-12 is 10.91% and the growth rate of the population is estimated as 1.77% per year (Indian labour Statistics 2012). Based on this information, the working population in construction sector is estimated state-wise for the year 2012. As per this record, in the NCT Delhi region, 619,767 persons are employed while 53,455,595 are employed all over the country in the construction sector in 2012.

Hämäläinen (2010) formulated accident rates for India by using the rates for Kazakhstan and the total rates for Malaysia to fill up the missing gaps related to occupational accident data of India. In India, the fatal accident rates per 100,000 employees in agriculture, industry, and service sector is estimated 10.2, 26.4, 6.9 respectively for 1998 and similarly 9.5, 18.3, 5.2 respectively for 2001 (Hämäläinen 2010). However, this study does not report the accident rate of Indian construction sector. Moreover, India is a vast country and it has geographical and economical diversity among the states. Therefore, it becomes essential to consider the quantum of the construction works in each state. But estimation of the amount of the construction work in a state seems difficult using direct measures. Thus an indirect measure such as the consumption of cement state wise was adopted to estimate the quantum of construction work.

This is because cement is the basic construction material and is used mainly for the construction works. The data of cement consumption per year is available on the web portal of Cement Manufactures Association (CMA). The proportion of consumption of the cement is derived for each state. The NCT Delhi consumes 3.8 million tonnes (2.20%) out of the total consumption of 172 million tonnes at the national level. Maharashtra state consumes 19.57 million tonnes. This is the highest among all the states. It shows that Maharashtra has the maximum amount of construction works. In brief, for extrapolating, measures such as the number of construction workers and cement consumption are selected to estimate the fatal accidents in the Indian construction sector.

Estimation of fatal accidents in Indian construction sector

The NCT Delhi has the total working population of 5,685,940 and so working population in construction sector is estimated to be 619,767 (=5,685,940 x 10.9%). The construction sector of the NCT Delhi consumed 2.20% (3.8 million tonnes) of the total national cement consumption in 2012. Under these circumstances, the accident rate, 256 fatal accidents per year, is derived in the construction sector for the NCT Delhi region (refer Table 1). Considering this data, accident rate of each state and union territory can be calculated using the linear extrapolation and interpolation methods. For illustration, Jammu and Kashmir has a total population of 4,399,225 in which 479,516 (= 4,399,225*10.9%) working population is associated with its

construction sector and the cement consumption was 0.46 million tonnes in 2012. Comparing with the number of fatal accidents and working population of NCT Delhi, Jammu and Kashmir should have a minimum 198 fatal accident (= 256 *479,516/619,767) for the year 2012, assuming safety standards are similar to that followed in the NCT Delhi. Similarly, considering the consumption of cement by Jammu and Kashmir state, and the NCT Delhi, number of fatal accidents is estimated to be 31 (=256*0.46/3.8). Thus, as shown in Figure 1, the estimated fatal accidents of each state and union territory based on its consumption of cement and population associated with construction sector is shown in the left side (31) and right side (59) respectively within a small bracket on the map of India, such as Jammu and Kashmir (31/59).
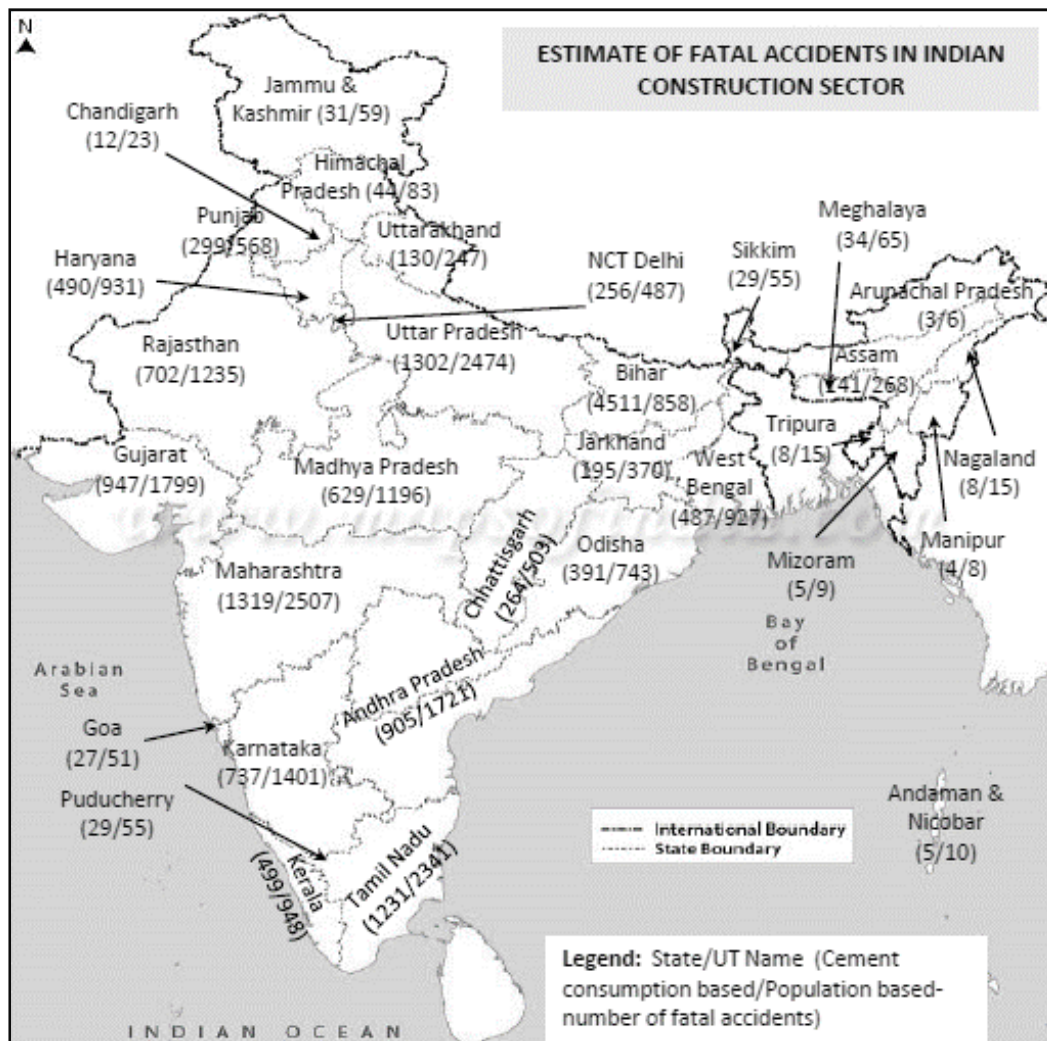

Figure 1. State-wise estimate of average annual fatal accidents in Indian construction sector from 2008-2012.

Based on this empirical analysis, in year 2012, approximately 11,614 and 22,080 fatal accidents might have occurred based on the consumption of cement and working population respectively in Indian construction sector. Estimate based on the cement consumption, 11,614 fatal accidents seems conservative because some construction projects may have activities where cement consumption may not be considerable, for example, excavation of lakes, construction of bituminous road, pipe laying, roofing work etc. Therefore, it is expected that the figure of real fatal accidents might be between 11, 614 and 22,080 in Indian construction sector. Thus, a minimum of

11,614 fatal accidents must be occurring in Indian construction. In other words, on an average 38 (=11,614/300 working days in a year) fatal accidents occur per day in Indian construction sector. Based on this data, the fatality rate (fatal accidents/1000 workers), of Indian construction sector works out to be 0.22. Indian Labour Statistics (2012 and 2013) estimates fatality rate of 0.24, 0.09, and 0.05 for coal mines, factories, and railways respectively. In terms of fatality rate, the data shows that the construction sector is second most hazardous in India. Although mining sector is the most hazardous in terms of fatality rate, it kills 84 persons as against the 11,614 minimum estimated fatal accidents in construction. This calls for adoption of stricter measures in construction.

DISCUSSION

As mentioned earlier, a few researchers (Hämäläinen 2010, Nelson et al. 2005, Leigh et al. 1997) estimated the occupational accident and disease at global and national level. However, in the Indian construction sector, this study has followed a novel and simple approach to estimate fatal accidents in the absence of reliable accident statistics. The estimates of fatal accidents presented in the previous section show poor safety performance of the Indian construction sector. The occupational health and safety policy should be focused on in every region and all types of construction works. This estimate will be useful to state governments to recruit labour officers and supervisor to monitor safety issues regularly. The accident statistics of construction sector should be collected, compiled and published by some designated agency or government body in India. These data will be useful to analyse and differentiate the trend of accidents in different sectors and regions. Time series analysis of such data will be helpful to review the implementation of occupation health and safety policy of the state or nation. Further research can be conducted to find out causes of accidents. Although there is a provision of keeping records of accident from construction sector, its implementation is not enforced. Whatever data are available, they are not reliable and complete. Every state government has its own labour ministry and a labour officer is available at each district level. Central government has a national informatics centre at each district head quarter. So, government can use these facilities and make a data collection network to collect the data regularly. Government should register the information about causes of death in the death certificate also. Leading newspaper and TV channels, insurance companies, hospital may be linked to this network to provide or verify the relevant information about accidents. The data will be helpful to know the causes of accidents and accordingly new policy may be framed to prevent accidents in future.

This study attempts to estimate only fatal accidents in the Indian construction sector, because the media do not cover and report the non-fatal accidents in all seriousness. The extrapolation and extension of results for the non-fatal accidents may cause large error and lead to misleading insights.

Moreover, this study does not include the investigation of causes of construction accidents, identification and implementation of the preventive measures. Several assumptions have been made to estimate the figures of fatal accidents. For example, it has been assumed that the safety management systems applicable in the NCT Delhi would be there throughout the country. Cement consumption has been directly related to the amount of construction and so on. Safety culture of each state may vary and depend on rules and regulations of that state. These limitations can be addressed in

future study. There is always a room to refine the study and to estimate more accurately.

CONCLUSIONS

Hämäläinen et al. (2010) estimated occupational accidents across the world. However, due to absence of a standard methodology to estimate accident statistics in the construction sector, this study attempted to estimate fatal accidents in the Indian construction sector. Generally many countries depend on their insurance sector and legislations to compile accident records. However, in India, insurance sector does not maintain such data separately for the construction sector and many accidents are under reported under legislations. Therefore, this study explores different types of sources where accidents statistics of construction industry may be available. Afterwards, this study relies on some reliable sources and estimates the fatal accidents for NCT Delhi region using linear extrapolation and interpolation methods. It extends derivation of the estimate at national level based on number of construction workers employed in states and their cement consumption.

As a result, in Indian construction sector, the number of people dying in construction could be anywhere from 11,614 to 22,080. Considering the minimum estimate of fatal accidents, i.e. 11,614, Indian construction sector alone adds 24.20% (=11,614*100/48,000) fatality in the total 48,000 occupational accidents occurring annually in India. The fatality rate (fatal accidents/1000 workers) of UK, Singapore, and Taiwan are reported to be 0.02 in 2013, 0.05 in 2012, and 0.125 in 2011 respectively in their construction sectors while fatality rate is estimated to be 0.22 in Indian construction sector as per this estimate. The comparison also shows the safety performance of construction industry in India in poor light in comparison to UK, Singapore and Taiwan. In fact, this estimate will draw the attention of various stakeholders of construction sector and motivate them to make safe work places and thus save the lives of workers.

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