

SAFETY PERFORMANCE EVALUATION OF CONSTRUCTION WORKERS IN GAUTENG, SOUTH AFRICA

Chioma Okoro¹, Innocent Musonda² and Justus Agumba³

^{1,2,3} School of Civil Engineering and the Built Environment; Department of Construction Management and Quantity Surveying, University of Johannesburg; Corner Siemert and Beit Street, Doornfontein 2028, Johannesburg, South Africa; +27738626360; chomasokoro@gmail.com

ABSTRACT

Purpose

The health and safety (H&S) of construction workers has been a subject of much deliberation and justifiably so, since construction workers are invaluable in construction processes. The paper presents findings on an assessment of safety performance of construction workers in the Gauteng province of South Africa.

Methodology

A field questionnaire survey was conducted to collect data regarding safety performance on sites. Participants were selected using heterogeneity and convenience sampling techniques. Data were analysed using Statistical Package for the Social Sciences, version 22 software. Mean values and standard deviation were computed.

Findings

The results of the study indicated that medical treatment beyond on-site first aid and limited work days were minimal among the participants. It was also found that poorer safety performance with regard to risk assessment before engaging in tasks and accepting any kind of work prevailed.

Research limitations/implications

The study included participants in only one province of South Africa and so the results may not be generalisable. Secondly, the study employed a quantitative approach which does not reveal further information about the reasons for some unsafe behaviours. Therefore, future studies could conduct a more in-depth study using qualitative or mixed methods.

Practical implications

The study provides evidence which could be beneficial in the psychometric evaluation of construction workers' safety behaviours on construction sites in order to identify and manage antecedents and consequences of unsafe behaviours.

Value

The current paper identifies potential areas for improvement in construction workers' safety performance. Construction employers and stakeholders would be enabled to develop measures to check the identified safety indicators and behaviours among their workers.

Keywords: Construction workers, Safety performance, South Africa

INTRODUCTION

The construction industry contributes immensely to the development of many economies. The sector accounts for about 10% of the global gross domestic product (GDP), 7 – 10% of the GDP in developed economies and 3 – 6% in underdeveloped economies^{1,2,3}. It contributes about 4% to the GDP of South Africa⁴. Not only is the industry a great contributor to GDP, but it is also the second largest employer worldwide (after agriculture)⁵, accounting for 7% of global employment, approximately 180 million construction workers worldwide^{1,5}, which is made up of about 75% in developing countries. In South Africa, the construction sector employs approximately 8% percent of the total labour force⁶. The construction sector provides much needed employment for many of the world's poorest and most vulnerable people⁵ and by so doing, alleviates poverty and improves living standards.

However, despite the undeniable contribution of the sector, its safety performance continues to be a source of concern. This is in spite of government efforts to deal with the problem in the form of legislations and regulations^{1,7}. Proper attention to workers' health and safety is beneficial and crucial since construction workers, especially craft workers (who are the focus in this study) are important human resources involved in the actual construction activities. Hence, more consideration should be given to the subject since injuries and fatalities can be reduced, employability of workers can be improved and productivity increased. Assessing safety performance of construction workers is an important consideration for improving H&S performance in the industry⁸.

Attention has been given to construction worker safety performance and behaviours, for instance, a study which investigated unhealthy behaviour of Spanish workers outside the work environment⁹; and a Ghanaian study which acknowledged that construction workers contributed to poor safety performance through non-adherence to safety procedures, refusal to wear personal protective equipment (PPE) or mere disregard for safety regulations, but focused on approaches to encourage construction worker safety performance sites¹⁰. More recently, the perceptions of Washington carpenters about reporting work injuries only were explored¹¹. It appears that little

literature has been devoted to actual safety performance and behaviours of the workers on worksites which contribute to the reported poor safety performance records, especially in South Africa. The objective of the present study is to evaluate safety performance of workers on construction sites in the Gauteng province of South Africa. Information on workers' safety behaviour would aid in identifying potential areas of improvement, which will inform subsequent development of strategies to stimulate proactive behaviours, and thus reduce the risk and occurrence of accidents on construction sites. Stimulating healthy behaviour is essential to achieve safe workplaces^{9,10}.

REVIEW

Health and safety performance in construction

Occupational accidents have been a source of immense consideration in many countries for over 100 years^{12,13}. Although a decline in the number of fatal injuries in recent years has been indicated, statistics still report unacceptably high rates of accidents, injuries and fatalities^{13,14,15}. Compared to other industries, the construction industry has the highest rates of fatalities and injuries, being responsible for 30 to 40% percent of world's fatal injuries^{1,16}. According to the International Labour Organisation (ILO), one in every six work-related fatal accidents occurs on a construction site¹⁵.

In Britain, the construction industry accounts for 27% of fatal injuries and 10% of reported major injuries¹⁷. Provisional statistics from the HSE indicated that there were 46 fatal injuries in construction in Britain, approximately 12% of total fatal injuries to both workers and passers-by¹⁵. In the United States of America (USA), the sector accounted for approximately 18% of total fatal work injuries in 2012, having recorded a total of 775 fatal injuries¹⁴.

In South Africa, the situation is no different. The building and construction sector is one of the high risk sectors. Construction motor vehicle accidents alone were 984 in 2010 and 892 in 2011¹⁶. Construction related fatalities total about 150 a year and the industry suffers about 400 accidents a year¹⁹. According to the Department of Labour, in 2010, there were 9858 accidents and 93 fatalities; in 2011, 8099 accidents and 50 fatalities were recorded, and 258 accidents and 56 fatalities in construction were reported in 2012, in the construction sector in South Africa¹⁹.

It is notable that construction H&S performance is universally poor, even in industrialized countries. The status quo established from even unreliable statistics of accidents is unacceptable, specifically with the South African construction industry which has seen an increase in accidents in recent years²⁰. There is a collective need to improve H&S performance in order to benefit all and sundry. Effective improvement strategies therefore need to be identified if the status quo is to be positively altered, especially since accidents cost human lives and incalculably devastating economic effects. The economy, employers and insurance companies not only face directly related accident costs (such as medical, hospital and rehabilitation expenses, workers compensation payments, and higher insurance premiums or even loss of insurability), but also long-term follow-up costs (for instance, loss in wages, loss of morale, legal costs, training costs, loss of skill/efficiency, administrative time, costs to repair damaged property), which are less obvious and usually greater than direct costs²¹.

Measuring of health and safety performance

Traditionally, safety performance has been measured by such metrics as the Occupational Health and Safety Administration (OSHA) record of accidents, injury and ill-health statistics^{22,23}. However, it has been argued that measuring H&S performance by the frequency of accidents and injuries is not always appropriate²². This is particularly true in settings where there is a low probability of accidents but where major hazards are present, such as construction worksites²². Further, gross under-reporting of accident and injury statistics renders such historical records unreliable and deceptive as indicators of safety performance. In some organizations, under-reporting occurs probably because health rates as a measure, particularly when related to reward systems, can lead to such events not being reported so as to 'maintain' performance. Hence, injury rates often do not reflect the potential severity of an event, merely the consequence; they reflect outcomes, not causes²².

Therefore, in addition to accidents, injuries and ill-health statistics, other safety performance indicators which are related to worker safety performance have been identified from various studies, although these studies dwelt heavily on safety management systems. An injury or illness that requires medical treatment beyond simple first aid is an Occupational Safety and Health Administration (OSHA) recordable injury²⁴. First aid involves a particular level of treatment such as cleaning and covering of wounds, use of non-prescription medication, etc; whereas medical treatment occurs when an injury or disease requires a higher degree of management and care to ensure a full recovery, for instance, suturing of wounds, treatment of fractures, and prescribing and providing drugs to manage symptoms^{25,26}. Medical treatment beyond on-site first aid is therefore an indicator of safety performance.

Other recordable indicators include restricted work, days away from work, significant injuries or illnesses diagnosed by physician and lost work day incidents²⁴. Days away from work, restricted duty and transferred duties are related to injuries which are severe enough that workers are away from work, placed on restricted duty or assigned a lighter job as a result of the injury. Concurring with this view, the ILO stated that loss of working capacity or inability to perform normal or routine work functions on the next calendar day after an injury reflects poor worker safety performance²⁷. Statistics on the days away from work or on restricted duty due to an injury are useful when analyzing how much loss is incurred from injuries²⁴. Lost work day(s) or lost time injuries are also useful in interpreting solutions to lowering the number of injuries and fatalities per year^{24,28}. Absence from work due to an injury, for more than three consecutive working days is considered serious and compensable^{13,27}.

Further, use of correct PPE was cited as an indicator of safety behaviour. This is one of the basic practices required for safety on construction sites²⁹. It is a performance issue which belongs to self protection category and can be used to indicate safety performance levels of firms^{25,29,30}. Workers face bodily harm when they do not wear PPE (and correctly). For instance, cement burns could be sustained without protective gloves and boots while cementing; falls from heights could occur with weak scaffolding and lack of safety belts; injuries could be sustained on fingers, eyes, head, or feet due to absence of PPE, and so on²⁹.

Another performance issue which is critical is the assessment of risks involved in a given task before embarking on it. The identification of the tasks, hazards and the risks of a job prior to work enables implementation of protective measures to ensure that work is done safely³¹.

In addition, near-misses or close calls were shown to be indicators of safety performance^{23,25,30}. Reporting of the near-misses and/or accidents is also crucial in reflecting workers' attitude and commitment to safety at the workplace. However, some workers may be reluctant or indecisive about reporting accidents or near-misses because sometimes there is no mechanism for compensation for injuries, and/or they may blame their luck which made them victims of the accident³².

The above-mentioned indicators relate to construction workers, prior to or after an incident. This implies that some indicators may be trailing (also called lagging indicators), providing data about incidents after the fact²³; whereas others may be prevailing (called leading indicators), potentially leading to an injury or incident²⁵. Both leading and lagging indicators reflect safety performance^{23,33}. The above-discussed indicators were considered suitable and thus adopted in the present study because the use of a set of safety performance indicators, in lieu of

one measure in isolation or indeed a small number of random measures, provides a greater indication of safety performance³⁴. In addition, the interpretations are related to the system and its operational context and are representative of what is to be measured and thus were deemed to be valid^{35,36}. Furthermore, good safety performance indicators should be quantifiable and permit statistical inferential procedures³⁶.

METHODS

Questionnaire design

After an extensive survey of literature related to H&S performance in the construction industry, a 5-likert scale questionnaire was developed. Worker safety performance measures were identified and used to draft a questionnaire containing 10 questions. The questionnaire was phrased in English language, with response categories ranging from “on every project”, “more than two times”, “two times”, “once before” to “never”, which were assigned weights 1, 2, 3, 4 and 5, respectively.

Data collection

The draft questionnaire was pilot-tested, reviewed and revised by experts before being self-administered to construction workers on construction sites. The results of the pilot study are however not included in the current paper as it was necessary to rephrase and simplify some of the questions before the main study. The participants included in the main study were selected through heterogeneity and convenience sampling. Heterogeneity sampling was employed because the aim was to include as many diverse views as possible³⁷. Eight construction sites in Midrand, Samrand, Centurion and Johannesburg were selected through convenience sampling. The participants included workers who were actively engaged in the physical construction activities as opposed to the site managers and supervisors. This group was chosen purposively as they were the most susceptible to poor safety performance on construction sites. Purposive sampling is based entirely on the judgment of the researcher and there is greater chance of personal bias, which could however, give good results if done with care¹⁰.

Ethical considerations were attended to while conducting the research. A cover letter accompanied the questionnaire to explain the purpose of the study to the workers and their managers and supervisors, from whom permission was obtained prior to administering the questionnaire. The participants were informed that participation was voluntary and that they were free to withdraw at anytime while responding to the questions. Anonymity and confidentiality of responses were assured and strictly kept to. Out of a total of 220 questionnaires distributed, 183 were returned and used for the empirical analysis.

Data analysis

As stated earlier, the response categories used in the study (“on every project”, “more than two times”, “two times”, “once before” and “never”) were assigned 1, 2, 3, 4 and 5 in reverse, respectively. Therefore, higher scores represent a higher safety performance. Mean (M) and standard deviation (SD) values were computed for the variables. The mean is the average score obtained from all weighted responses on the 5-point likert scale. The mean scores were compared based on interval ranges or values between the points. Likert scale data can be analyzed with an interval measurement scale as this reflects meaningful relative distances between points³⁷. Standard deviation values reflect the extent to which individual responses are digressed from the mean.

Validity and reliability

Various measures were taken to ensure that the variables developed from extant literature and subsequent results are valid and reliable. Through a detailed literature review and synthesis, expert reviews and validation as well as pilot-testing of the questionnaire, construct validity of the theoretical variables was achieved³⁸. Additionally, through the inclusion of construction workers in different parts of Gauteng, generalisation (external validity) was enhanced³⁸. Cronbach’s alpha was used to statistically assess the internal consistency reliability of the scale. The alpha index was 0.83, indicating good internal reliability³⁹. The questionnaire was considered to be reliable and representative of what was to be measured^{36,39}.

RESULTS AND DISCUSSION

Respondents were asked to indicate the extent to which statements regarding their safety performance on construction sites related to them. From table 1, it can be seen that 78% of the participants had *never been treated medically for injuries (beyond first aid on site)* (M=4.63, SD=1.262) or *been asked to do limited work after an injury* (M=4.60, SD=1.418), respectively. With their highest recorded Ms, it can be deemed that medical treatment and limited work days were minimal among the participants, since higher scores represent better safety performance (as stated earlier). On the other hand, *failure to wear PPE* (M=4.24, S=0.972), *failure to consider possible risks in a task* (risk assessment) (M=4.05, S=0.871), and *accepting any kind of work, not minding the risk involved* (M=3.69, S=0.951) recorded the lowest Ms, suggesting poorer safety performance.

Although 67% (a seemingly good percentage) of the respondents reported that they *never failed to wear PPE*, 33% reported otherwise. A possible explanation for the 33% responses could be that the workers felt

uncomfortable wearing PPE while working, a view articulated in a study among Latino residential roofers in which participants believed that wearing PPE made them uncomfortable and hindered their productivity, and thus jeopardising work safety⁴⁰.

It is noteworthy that 19% of the participants *accepted any kind of work on every project*, regardless of risks involved. It can be deemed that the participants in this category have no misgivings about engaging in dangerous tasks as long as they are employed. The construction industry has no difficulty attracting labour even where the wages are very low⁴¹. This further suggests that construction workers are low-paid and probably have no choice but to take any job even without considering the risks involved, as evinced by the 10% who reported failure to consider possible risks on every project.

It is also notable that the responses were concentrated on the “never” category. This suggests that the respondents can be deemed to have had no incidence with regard to safety performance on construction sites. Such work injury records may either reflect safe work conditions or under-reporting¹¹. Workers may be inclined to conceal incidences for fear of repercussions from management or fellow workers. That 75% of workers *never failed to report an accident or incident* corroborates findings from the study among Washington carpenters which reported that the same proportion of the participants felt that they could report work-related injuries without fear of retribution, while some (nearly half) considered it best not to report minor injuries¹¹. In many developing countries, scores of accidents and injuries go unreported¹⁰. Formal and informal policies and practices on jobsites such as close and strict supervision and monetary rewards could increase reporting of injury^{10,11}.

Table 1 Findings on safety performance of the study participants

Measures	Responses (%)					Mean	SD
	On every project	More than two times	Two times	Once before	Never		
	1	2	3	4	5		
Been treated medically for injuries (beyond first aid on site)	2	2	4	14	78	4.63	1.262
Been asked to do limited work after an injury	1	5	5	12	78	4.60	1.418
Been involved in incidents or near-misses	2	5	3	16	74	4.53	1.615
Been away from work for more than three days due to an injury	3	4	6	12	75	4.53	.994
Failed to report an accident or incident	3	5	4	13	75	4.52	1.048
Been injured at work	3	6	6	22	63	4.35	1.023
Been sick at work	2	8	8	25	58	4.29	.843
Failed to wear personal protective equipment (PPE)	6	9	7	11	67	4.24	.972
Failed to consider possible risks in a task	10	11	6	11	62	4.05	.871
Accepted any kind of work, not minding the risk involved	19	9	9	10	53	3.69	.951

CONCLUSION

The study sought to evaluate the safety performance of construction workers. This objective has been met. By identifying aspects of safety workers may be lacking in performance, the study has highlighted possible areas for improvement in construction workers' safety performance. Construction stakeholders and employers would be enabled to develop measures to check the identified safety indicators and behaviours among their workers. Continuous behavioural orientation and instruction could also engender positive thinking and behavioural change. Formal and informal policies could be effective in encouraging and motivating construction workers to improve on their safety performance. Construction workers' recalcitrant and sheer nonchalant safety behaviours could also be altered with incentives or monetary rewards.

The present study has some limitations. It includes only participants in one province of South Africa and so the results may not be generalizable. Additionally, the study employed a quantitative approach which does not reveal further information about the reasons for some unsafe behaviours (especially with regard to the leading safety indicators). Therefore, future studies could conduct a more in-depth study using qualitative or mixed methods. More investigation is required to validate or refute the skewed responses in the "never" category. Future studies could as well expand the number of workers and explore differences in safety behaviour among different construction trades.

ACKNOWLEDGEMENT

The present paper is part of a Master's research conducted with the aid of the University of Johannesburg's Global Excellence and Stature Scholarship awarded to Chioma Okoro. The study would not have been possible without the scholarship grant.

REFERENCES

- [1] Murie, F. (2007). Building safety: An international perspective. *International Journal of Occupational and Environmental Health*, 13:5-11.
- [2] Giang, D. T. H. and Pheng, L. S. (2011). Role of construction in economic development: Review of key concepts in the past 40 years. *Habitat International*, 35(1):118-125.

- [3] Osei, V. (2013). The construction industry and its linkages to the Ghanaian economy – Policies to improve the sector's performance. *International Journal of Development and Economic Sustainability*, 1(1):56-72.
- [4] Statistics South Africa. (2014a) Gross domestic product: Second quarter. *Statistical Release P0441*. Pretoria: Statistics South Africa.
- [5] Women in Informal Employment: Globalizing and Organizing (WIEGO). (2014). Construction Workers in the Informal Economy. WIEGO.
- [6] Statistics South Africa. (2014b). Quarterly labour force survey: Quarter 4. *Statistical release P0211*. Pretoria: Statistics South Africa.
- [7] Agumba, J. N. (2013). A construction health and safety performance improvement model for small and medium enterprises. *Doctoral Thesis*. University of Johannesburg: South Africa.
- [8] Huang, Y. Zohar, D., Robertson, M. M., Garabet, A., Lee, J. and Murphy, L. A. (2013). Development and validation of safety climate scales for lone workers using truck drivers as exemplar: Transportation research part F. *Traffic Psychology and Behaviour*, 12:5-19.
- [9] Melia, J. L. and Becerril, M. (2009). Health behaviour and safety in the construction sector. *Psicothema*, 21(3): p.427+
- [10] Fugar, F. D. K., Darkwa, J. O., Ohene, E. and Donkor, D. (2010). Encouraging safety work behaviour of construction workers: Which is the best approach? *The Surveyor*, 3(1).
- [11] Lipscomb, H. J., Schoenfisch, A. L. and Cameron, W. (2015). Non-reporting of work injuries and aspects of jobsite safety climate and behavioural based safety elements among carpenters in Washington State. *American Journal of Industrial Medicine*, 58(4):411-421.
- [12] Hamalainen, P., Saarela, K. L., and Takala, J. (2009). Global trend according to estimated number of occupational accidents and fatal work-related diseases at region and country level. *Journal of Safety Research*, 40:125-139.
- [13] Cameron, I. and Duff, R. (2007). A critical review of safety initiatives using goal setting and feedback. *Construction Management and Economics*, 25(5):495-508.
- [14] Bureau of Labour Statistics. (2013). National census of fatal occupational injuries in 2012: Preliminary results. *News release*. Department of Labour: United States of America.
- [15] Health and Safety Executive (HSE). (2014). Statistics on fatal injuries in the workplace in Great Britain. HSE Books.

- [16] Construction Industry Development Board (CIDB). (2009). Construction health and safety in South Africa. Construction Industry Development Board: South Africa.
- [17] Health and Safety Executive (HSE). (2013). Health and safety in construction in Great Britain: Work related injuries and ill health. HSE Books.
- [18] Emuze, F. and Smallwood, J. (2013). Construction vehicle accidents in SA: causes and impact. Proceedings of the 29th Annual conference held in Reading, United Kingdom. Smith, S. D. and Ahiaga-Dagbui, D. D. (eds.)
- [19] Prinsloo, L. (2013). Death and injury stalk construction sites. *Business Times*. South Africa.
- [20] Musonda, I. (2012). Construction health and safety performance improvement: A client-centred model. *Doctoral thesis*. University of Johannesburg, South Africa.
- [21] Thepaksorn, P. and Pongpanich, S. (2014). Occupational injuries and illness and associated costs in Thailand. *Safety and Health at Work*, 5(2):66-72.
- [22] Health and Safety Executive (HSE). (2001). A guide to measuring health and safety performance. HSE Books.
- [23] Hinze, J., Thurman, S and Wehle, A. (2013). Leading indicators of construction safety performance. *Safety Science*, 51(1):23-28.
- [24] ElSafty, A., ElSafty, A. and Malek, M. (2012). Construction safety and occupational health education in Egypt, the European Union and United States firms. *Open Journal of Civil Engineering*, 2:174-182.
- [25] Biggs, H. C., Dingsdag, D. P., Kirk, P. J. and Cipolla, D. (2009). Safety Culture Research: Leading indicators and the development of safety effectiveness indicator in the construction sector. *Proceedings of the 5th International Conference on Knowledge, Technology and Society*, 30Jan – 1 Feb., 2009. Huntsville, Alabama: Unites States of America.
- [26] International Council on Mining and Metals (ICMM). (2014). Health and safety performance indicators. ICMM, London: United Kingdom.
- [27] International Labour Organization (ILO). (2003). Safety in numbers: Pointers for global safety culture at work. ILO, Geneva.
- [28] Dingsdag, D P. and Biggs, H. C. and Cipolla, D. (2008). Safety effectiveness indicators (SEI's): Measuring construction industry safety performance. *Proceedings Third International Conference of the Cooperative Research Centre (CRC) for Construction Innovation – Clients Driving Innovation: Benefiting from Innovation*, Gold Coast, Australia.

- [29] Farooqui, R. U., Arif, F. and Rafeeqi, S. F. A. (2008). Safety performance in construction industry of Pakistan. *Proceedings of the First International Conference on Construction in Developing Countries*, August 4-5, Karachi, Pakistan.
- [30] Construction Industry Institute (CII). (2014). Measuring safety performance with active safety leading indicators. CII.
- [31] Campbell Institute. (2014). Practical guide to leading indicators: Metrics, case studies and strategies. National Safety Council: United States of America.
- [32] Masood, R., Mujtaba, B., Khan, M. A., Mubin, S., Shafique, F. and Zahoor, H. (2014). Investigation for safety performance indicators on construction projects. *Sci.Int. (Lahore)*, 1403-1408,2014
- [33] Lingard, H., Wakefield, R. and Blismas, N. (2013). "If you cannot measure it, you cannot improve it": Measuring health and safety performance in the construction industry. *Proceedings of the 19th CIB World Building Congress*, 5-9 May, Queensland University of Technology, Brisbane: Queensland.
- [34] Atkins, W. S. (2011). Development of suitable safety performance indicators for level 4 bio-containment facilities: Phase 2. Health and Safety Executive (HSE).
- [35] Herrera, I. A. (2012). Proactive safety performance indicators. *Doctoral Thesis*. Norwegian University of Science and Technology, Norway.
- [36] Roelen, A. L. C. and Klompstra, M. B. (2012). The challenges in defining aviation safety performance indicators. Preprint for PSAM II and ESREL, 25-29 June, 2012, Helsinki: Finland.
- [37] Trochim, W. M. K. (2006). External validity. *Research Methods Knowledge Base*. Web Centre for Social Research Methods.
- [38] Olson, K. (2010). An examination of questionnaire evaluation by expert reviewers. *Field methods*, 22(4):295-318.
- [39] Pallant, J. (2013). SPSS survival manual: A step by step guide to data analysis using IBM SPSS. 5th edition. Allen and Unwin, Australia. pp. 101, 193, 199 and 207.
- [40] Arcury, T. A., Summers, P., Rushing, J., Grzywacz, J. G., Mora, D. C., Quandt, S. A., Lang, W. and Mills, T. H. (2014). Work safety climate, personal protective use and injuries among Latino residential roofers. *American Journal of Industrial Medicine*, 58(1):69-76.
- [41] International Labour Organisation (2001). The construction industry in the 21st century: Its image, employment prospects and skill requirements. Geneva: ILO.