CONSTRUCTION HEALTH AND SAFETY: A SCIENTOMETRIC ANALYSIS

SAMUEL ADENIYI ADEKUNLE, CLINTON AIGBAVBOA, and MATTHEW IKUABE
SARChl in Sustainable Construction Management and Leadership in the Built Environment, University of Johannesburg, Johannesburg, South Africa

Health and safety culture has received a lot of attention across the construction industry. The effect of poor health and safety culture includes but not limited to decreased productivity, cost implication, among others. Although many studies have been conducted on construction health and safety culture, however, there exists a dearth of systematic studies using visualization. This study reviews published research in the Scopus database in construction health and safety in the South African construction industry from 1999 to 2020 using scientometric analysis. The study visualized the different clusters (for example keywords, citation). The research themes over the years was critically and objectively identified. The study classified the construction health and safety research in the South African construction industry into five eras. It was observed that the present research focus is discussing health and safety in light of technological advancement. Although an important research area, there exist not so much attention by researchers and it was also observed that there is a lack of collaboration among researchers in this research focus. This paper presents an in-depth description of construction health and safety in the South African construction industry.

Keywords: Health and safety, Accident prevention research, Developing countries, Visualization.

1 INTRODUCTION

The construction industry is an important industry with many identified advantages. It affects and is relevant to the growth of the economy hence it affects every facet of society. For instance, it contributes 6% of the global GDP (5% contribution to GDP in developed countries and 8% in developing countries)(Industry Agenda 2016). Meanwhile, the construction industry is a busy industry with activities executed simultaneously. It involves different participants and stakeholders working together to achieve the project. This complex nature of the construction industry makes it prone to accident and safety challenges.

Traditionally, the construction industry is labour-intensive and activity prone due to human activity. Thus, the accident experienced on a construction site are always massive and fatal. It affects labour availability for instance between 2005 and 2014, 21% of fatalities among young workers was in the construction industry(Christian 2015). It also leads to a shortage of labour availability (Aiyetan and Dillip 2018) as the construction industry will be less fancied by prospective manpower. Haupt and Pillay (2016) opined that the presence of unsafe construction environment has a huge impact on the construction project as it comes at a huge cost.

The source of accidents in the construction industry are through human error, the use of machinery, equipment among others. Ranking this causes, the leading cause of injuries are: contact.
with cutting or piercing objects, being struck by objects are the second-largest cause of injuries, and the third cause of injury on site was falling (Welch et al. 2005). Machine related fatalities in the construction industry were caused by crane, excavating machine, tractor, loader, paving machine and forklift (Pratt et al. 1997). Events identified to be related to machinery fatalities are being struck, pinned, crushed or run over, entangled or compressed between running machinery, fall-related among others (Pratt et al. 1997). Other causes of fatalities on construction sites are collision with vehicles and contact with electricity (Safe Work Australia 2015). The leading causes of construction fatalities have been broadly termed the construction “fatal four”, they are falls, followed by struck by an object, electrocution, and caught-in/between (OSHA 2018). The fatality of the accident on site depends on the size and causes of the accident. Other factors are the adherence to safety precautions, use of protective equipment among others.

According to the International Labor organisation (ILO), globally, 60,000 fatal accidents happen annually in construction (one every ten minutes). The industrialised world is reported to have more than 24%-40% of work-related deaths from construction sites. For instance in Australia, a study conducted over 12 years (2002/03 to 2013/14) observed that 14% of all Australian workers fatalities was contributed by the construction industry (Safe Work Australia 2015). In the USA, the construction industry contributed 21.1% of worker fatalities in private industry in 2018 (OSHA 2018). The developing nations are not exempted from this construction safety challenges. A CIDB sponsored report undertaken by Smallwood et al. (2009) reported an increase in construction industry fatalities in South Africa. Although the data available to the report covered 2004/05 to 2007/08, the cause of these fatalities are mostly the fatal fours. The report also identified the absence of safety programs, no proof of health and safety induction amongst others as some of the root causes.

In order to understand the root cause of these rising figures and proffer solutions, researchers have studied this phenomenon. The continuous spike in the case of accidents in the construction industry has made it notorious for being unsafe. Studies have been conducted to unearth the culture of the construction industry in light of health and safety.

2 ACCIDENTS IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

Considering the rate of construction-related fatalities in the South African construction industry, this study seeks to unearth the research efforts in construction safety. The South African construction industry in preparation for the 2010 world cup organized by FIFA had a busy time constructing football stadia. Thus, it presents a good study area for construction health and safety. One of the incidents reported during the stadia construction for the 2010 World cup was the death of a construction worker. Some other recently recorded construction accidents are shown in Table 1 and include:

<table>
<thead>
<tr>
<th>Accident</th>
<th>Cause</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three construction workers died, and five others were injured in Durban</td>
<td>A falling concrete slab</td>
<td>Timeslive (2018)</td>
</tr>
<tr>
<td>In 2018, 8,384 accidents recorded</td>
<td>Fall from heights(ladders, platforms, skylights etc)</td>
<td>IOL (FEM) (2019)</td>
</tr>
</tbody>
</table>

According to the Department of Labour (2017) the South African construction industry has at least 1.5 to 2.5 fatality rate per week. Based on these data, this study seeks to review existing
research efforts on H&S in the South African construction industry in order to identify the research focus, trend and theme. This study will also identify the gaps and areas requiring further study based on the findings.

3 RESEARCH METHODOLOGY

The publications on health and safety in the South African construction industry was retrieved from the Scopus database. The query adopted were “construction safety”, “construction health and safety” and “construction safety culture”. The retrieved data spanned 1999-2020. The other limitation applied to the search is the country which is South Africa. This returned a total of 184 publications, after refining the results for relevance to the study objective, a total of 89 documents were adopted. This was mainly most of the publications that were removed were either duplicate or they are collaborations but were not conducted in the South African construction industry space. VOSviewer was used to achieve visualization of the collected data that was downloaded from the Scopus database. The technique of analysing and visualizing a large dataset is known as scientometric. This has been adopted in many studies for reviews (Aghimien et al. 2022, Adekunle et al. 2022, Jin et al. 2019, Zhong et al. 2019). To achieve the objective of this study, VOSviewer version 1.6.15 was adopted. It is a free software and it is user friendly while providing relevant output for the study.

4 RESULTS ANALYSIS AND VISUALIZATION

4.1 Annual Publication Trend

Data collected shows that the first publication on construction health and safety in the South African construction industry dates back to 1999. It has increased afterwards but in a fluctuating manner yearly as presented in Figure 1.

4.2 Co-Authorship Network

Table 2 presents the productive output as regards the contribution of each author to the H&S discussion and their citation. In terms of citation, Smallwood (Smallwood 2002, Smallwood 2020a, Smallwood 2020b) is more prominent and has more publication contribution too. Other productive researchers in this space are Emuze (Emuze and Smallwood 2012, Emuze 2018) and Haupt (Haupt and Pillay 2016). It is noteworthy that the number of published articles does not translate to citation frequency. As there are authors with fewer publications but with more citations for instance Mbowha and Skeepers.

4.3 Co-Occurring Keywords Network

This shows the co-occurring keywords in the publications. By extension, it shows the trend and research theme in the construction H&S space in South Africa. The minimum frequency of keyword occurrence was set to 3 so as to capture that all relevant keywords were captured. The colours indicate the year trend for the keywords, for instance, yellow indicates keywords found in publications in 2016 and beyond. The trend in publication theme in recent years tend towards the fourth industrial revolution, impact of human actors, design process among others to improve construction safety.
Looking at studies before 2006, their focus was on the disease (AIDS), regulatory framework. A critical study of Figure 6 reveals that the trend of H&S studies in the South African construction industry can be classified into five trends, achieved through keyword analysis. This classification is based on the timeline and colour designation, the five research trends are:


A critical look at the results reveals that the research focus has metamorphosed from micro to macro level. Also, it has become 4IR oriented and safety is been given a processual perspective. However, it is noteworthy that the construction health and safety research in South Africa does not get enough attention. Furthermore, there is a dearth of collaborations among researchers.
5 CONCLUSION AND RECOMMENDATIONS

A careful look at the trend shows that emphasis is being placed on safety implementation through a conscious effort at the design stage. Studies are beginning to advocate for safety before the construction on site. This has prompted the study of the economic and social effects and considering safety from the design and prequalification stage. It is, however, noteworthy that the application of the technological tool in the 4IR space is still developing and it is a grey area in the South African H&S space. This applies to a safety culture that incorporates the unskilled labours and tradesmen on construction site especially those who are not permanent employees of contracting organisations. They are the most valuable as they accept any type of job without proper risk assessment, this might be attributed to the drive to make a living. Furthermore, using the safety culture model by Choudhry et al. (2007), more research work is needed in the environment and behaviour variables; these are yet to be fully explored in the South African construction industry.

References


