

## Measuring the Causes of Saudi Arabian Construction Accidents: Management and Concerns

Moosa MH<sup>1,2</sup>, Oriet LP<sup>1</sup>, Khamaj AM<sup>2</sup>

<sup>1</sup>Faculty of Engineering, University of Windsor, Windsor, Canada <sup>2</sup>Department of Industrial Engineering, Jazan University, Jazan, Saudi Arabia

### ABSTRACT

**Introduction:** Research indicate that construction site accidents are a global concern, and rates are rapidly increasing. In developing countries such as Saudi Arabia, safety issues are frequently ignored, and little is known about their causes.

**Objectives:** This study aimed to shed light on factors causing accidents in Saudi Arabian construction companies.

**Methods:** An online detailed survey, using Google Form, of accident features was distributed randomly to potential employees in 35 construction companies in Saudi Arabia, where one of the top administrators or safety officers were required to respond to the survey. It was conducted from 1<sup>st</sup> June to 31<sup>st</sup> August, 2013. The safety practices and perceptions of accident causes were assessed.

**Results:** The response rate was 63%. Over half of the surveyed organizations encountered all of the selected accident types. While 19 (86%) of the construction companies maintained the equipment regularly, 15 (68%) had regular maintenance staff and 13 (59%) inspected the equipment before use. Although 18 (82%) of the workers were supplied with personal protective equipment (PPE), only 12 (55%) emphasized its use and offered site orientation for new employees. In the last part of the survey, respondents were requested to rate 25 factors affecting safety performance at the construction sites on a scale of 1 to 5, with 5 being the most important. The three most important factors of poor safety performance were the firm's top leaders, a lack of training, and the reckless operation of equipment.

**Conclusion:** Changing attitudes of surrounding safety culture have the potential to significantly improve safety outcomes in the Saudi Arabian construction industry. Two Saudi Arabian corporations, Saudi Aramco and Saudi Chevron Petrochemical provide a positive model for increasing construction safety in the country, but there is a paucity of industry-level data. Further scholarly attention is strongly indicated.

**Key words:** Accident, Construction, Injury, Safety, Workplace.

### Introduction

In countries where development is booming, standards for construction site safety is inadequate which can be hazardous from an occupational safety perspective.<sup>1-3</sup> It is especially true for Saudi Arabia

because it is heavily reliant on a diverse workforce in which foreign employees are disproportionately represented and construction site safety are often ignored. Thus, Saudi Arabia has contributed to the growing number of construction site accidents in contrast to developing countries such as Canada.<sup>4,5</sup>

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#### Corresponding Author

Dr. Majed H Moosa,  
Assistant Professor,  
Department of Industrial Engineering,  
Jazan University, Jazan,  
Saudi Arabia.  
Tel: +966547778833  
E-mail: [moosam@uwindsor.ca](mailto:moosam@uwindsor.ca)



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equipment, technology, and industrial relationship and risk factors may vary as a function of cultural and other contexts.<sup>6</sup> The companies need to understand the necessity of safety measures to save both lives and money.<sup>7</sup> The attitudes of management and workers towards safety are major causes of accidents. In some sense, this is encouraging for practice-oriented researchers: behaviors may directly or indirectly constitute a major driver of construction accidents. The behaviors depend upon the interlocking attitudes of managers and workers toward safety practices often represented as a safety culture or a safety climate, play a particularly notable role. However, the specific way in which safety culture is manifested behaviorally is highly context-dependent.<sup>8</sup> Accidents cost money in terms of lost time, labor, and possibly equipment, depending on accident type. If management can be persuaded to invest in safety, they might see a significant return in investment.

Saudi Arabia has a strong economy and advanced infrastructure. Large sectors such as construction have contributed to its overall growth. The construction industry plays a vital role. Construction employs constitute just over 40% of the country's workforce. The country's construction industry now accounts for 41% of Saudi Arabia's private-sector labor force, with 2,174,962 workers. As indicated above, the number of workplace injuries in Saudi Arabia's construction industry is relatively high where most work injuries, represent 48% (or 32,557) of total injuries in 2018.<sup>4</sup> It should be noted that in Saudi Arabia, many construction employees are not registered and do not hold a license to work in the field. As a result, these workers cannot be included in the official statistics reports. Therefore, the accident rate is likely higher than the reported number. In Saudi Arabia, the government does not regulate construction safety, the duty falls upon the management of construction company itself, yet many companies do not follow the standard protocol.<sup>7</sup>

Unfortunately, empirical data regarding the causes and conditions underlying the unusually high accident rates observed in the Saudi construction industry is relatively scarce. This study, therefore, sought to make a modest contribution to this gap in the research literature through a detailed questionnaire administered to prominent construction companies operating in the country to fulfil the following objectives of the survey such as to determine the most common types of accidents and to evaluate current safety practices.

## Methods

To meet the objectives stated above and to address the research gap in Saudi Arabian data, a new survey was created that combined Al-Kaabi's survey<sup>9</sup> with Tam et al.'s survey.<sup>6</sup> The online survey was built using Google Documents and was open for participant responses for three months, starting from 1<sup>st</sup> of June, 2013 and closing at the end of August 2013. It was mailed to 35 random well-known Saudi Arabian construction company representatives, including project managers, directors, and safety officers. Participation was voluntary and confidential. Out of 35 companies, 22 responded to our request, yielding a response rate of 63%. The survey was divided into sections and included general questions about the participants' construction companies, in addition to explicitly safety-oriented items. Topics included company size and years in business, equipment safety and maintenance, accident and injury history and procedures, worker safety, site safety, and safety organization.

This study was granted ethical approval by the College of Engineering, Jazan University.

## Results

Of the 22 survey respondents, 20 (90%) have experienced construction accidents involving a fall from elevation; 15 (68%) have experienced accidents involving electrocution; 13 (59%) have experienced accidents involving falling materials, and 11(50%) have experienced accidents involving fire. Over half of the surveyed companies experienced all of the above accident types. A smaller number of accidents involved a worker having been struck by equipment; having been caught in equipment or materials; or experienced explosions, cave-ins, drownings, asphyxiations, ground-level falls, or natural causes (Fig.1).

Although 19 (86%) of the construction companies have performed equipment maintenance, only 15 (68%) have had maintenance staff and only 13 (59%) have inspected the equipment before use (Fig.2). While 18 (82%) have provided workers with personal protective equipment (PPE), only 12 (55%) have emphasized its use and have provided some sort of new-worker site orientation (Fig.3).

Safety methods such as signs, fences, and shelters have been used by over 18 (80%) of the companies surveyed, but only 8 (36%) have used guard rails. Only

3 (14%) have used safety nets, and unfortunately and 3 (14%) have used nothing (Fig.4).

In the final section of the survey, respondents were asked to rate 25 factors affecting construction site safety on a scale of 1 to 5, with 5 being the most important. Majority of respondents (82%) rated a lack

of certified skilled labor as most the important factor (Table 1). The next three most important factors of poor safety awareness were their firm's top leaders, a lack of training, and the reckless operation of equipment. These can all be considered as management issues. Furthermore, management and resource issues accounted for the remaining top ten factors.

**Table 1:** Factors affecting construction site safety

Ranking	Factors	Saudi Arabia					China <sup>7</sup>	
		Scale 1 to 5 (%)					Most Important	Ranking*
		5	4	3	2	1		
1.	Lack of certified skill labour	82	5	5	8	0	84	6
2.	Poor safety awareness of firm's top leaders	77	13	5	5	0	93	1
3.	Lack of training	68	23	0	9	0	90	2
4.	Poor safety awareness of project managers	59	31	5	5	0	89	3
5.	Reckless operation	59	22	14	5	0	86	5
6.	Lack of experienced project managers	50	36	9	5	0	54	17
7.	Poor equipment	41	36	9	14	0	82	7
8.	Reluctance to input resources for safety	32	45	14	9	0	86	4
9.	Lack of organization commitment	32	32	18	18	0	71	10
10.	Ineffective operation of safety regulation	23	45	27	5	0	59	14
11.	Poor safety conscientiousness of workers	23	18	45	9	5	65	12
12.	Low education level of workers	18	59	9	14	0	68	11
13.	Lack of personal protective equipment	18	58	5	14	5	62	13
14.	Lack of rigorous enforcement of safety regulations	18	54	23	5	0	74	9
15.	Lack of strict operational procedures	14	35	41	5	5	55	16
16.	Poor information flow	14	14	18	27	27	40	25
17.	Shortfall of safety regulation	9	63	23	0	5	53	18
18.	Lack of first aid measures	9	55	23	9	4	81	8
19.	Lack of technical guidance	9	36	50	0	5	55	15
20.	Lack of protection in material transportation	9	27	32	23	9	53	19
21.	Lack of teamwork spirits	9	14	23	45	9	50	21
22.	Excessive overtime work for labour	9	14	14	50	13	49	22
23.	Lack of protection in material storage	9	9	18	64	0	51	20
24.	Shortage of safety management manual	5	32	41	14	8	48	23
25.	Lack of innovation technology	5	9	9	36	41	43	24

\*Tam et al.<sup>7</sup> used a relative importance index in their ranking

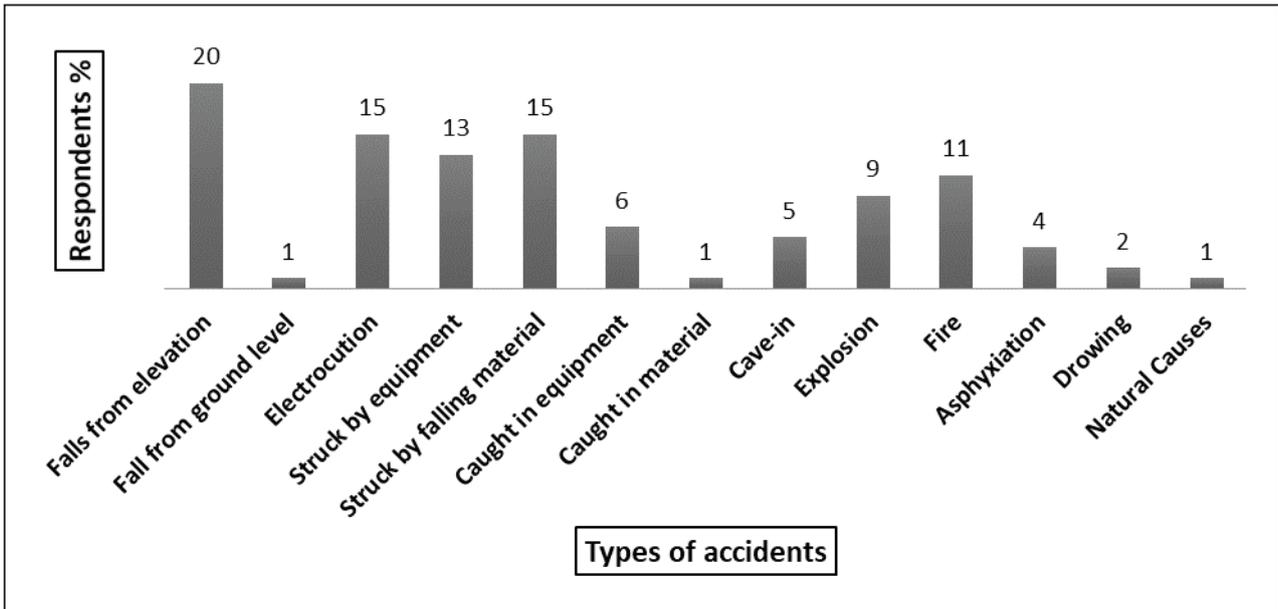


Figure 1: Types of accidents at construction sites

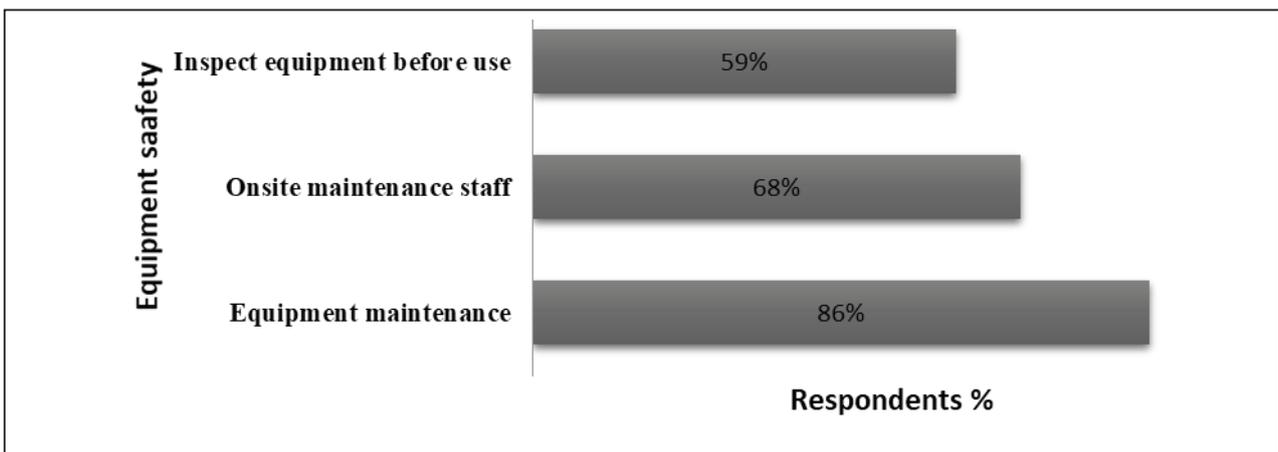


Figure 2: Equipment safety in Saudi Arabia

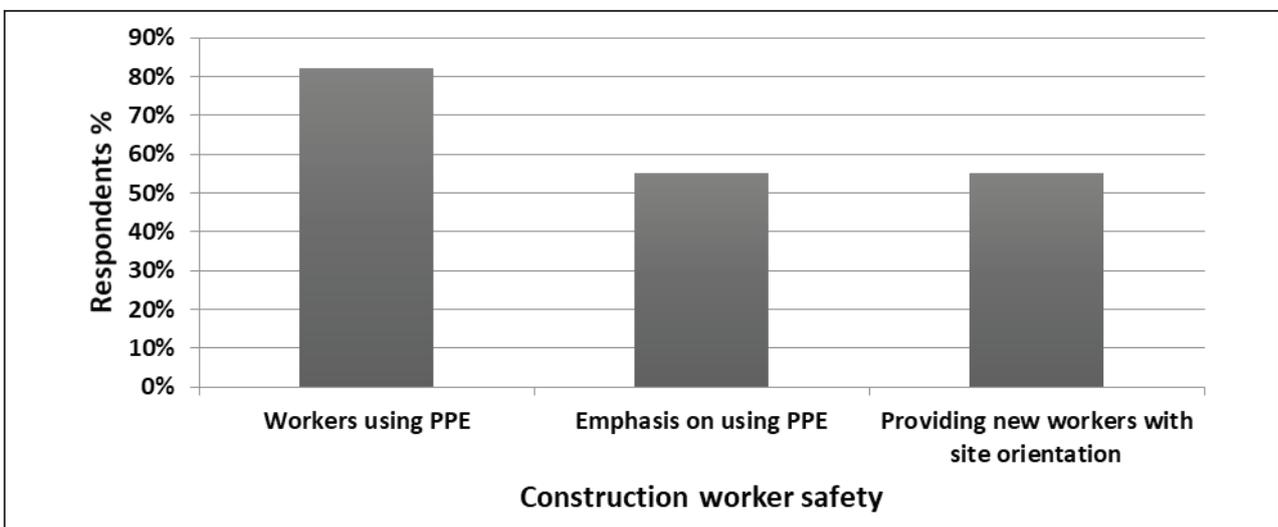
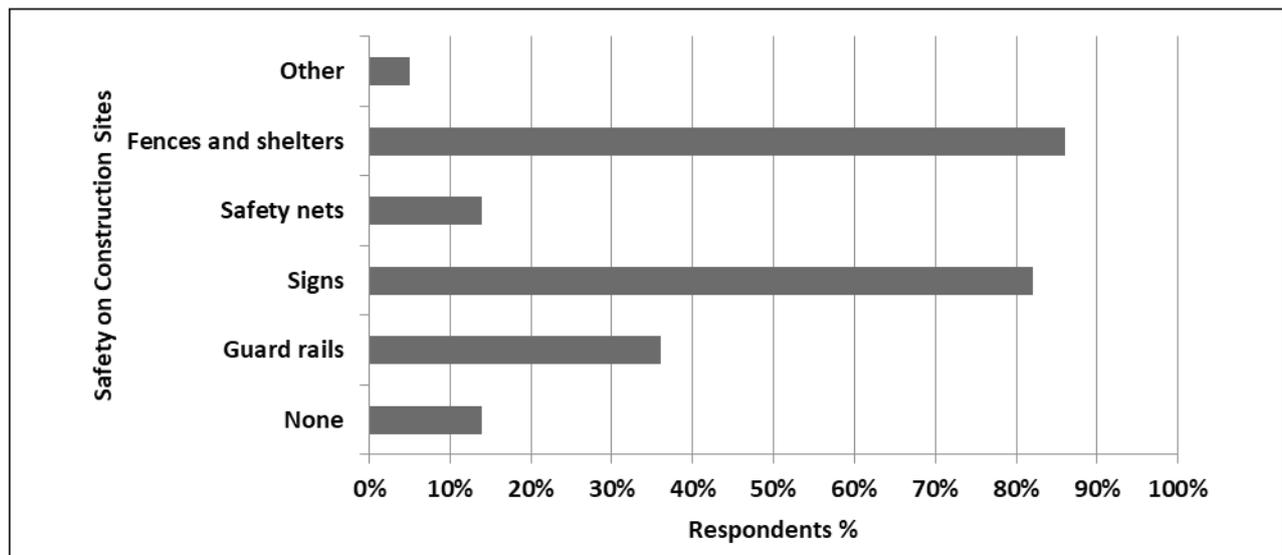


Figure 3: Construction worker safety in Saudi Arabia



**Figure 4:** Safety on construction sites in Saudi Arabia

## Discussion

Almost all the accidents listed by the present study are preventable; these are common scenarios that can, for the most part, be readily avoided through robust safety and security policies and practices. The lack of certified skilled labor was identified as a factor but the reasons behind it could be either unskilled laborer or financial issues or reluctance for safety factors. It suggests a direct relation between safety factors and personal attitudes. Studies conducted by concerning the size of an organization and conditional safety measures gives some insight into the Saudi Arabian construction industry. Saudi Aramco, an oil-producing company, conducts both planned and surprise safety inspections at its sites. Besides, it publishes a wide array of safety materials.<sup>7</sup> Whereas Saudi Chevron Petrochemical (SCP) demands that its employees and contractors pay close attention to safety details by adopting “injury-free policy”. This policy has been applied at most of the construction companies in the Saudi’s neighbor, the United Arab Emirates.<sup>10</sup> Raouf and Dhillon identified two models for studying the causes of workplace accidents in Saudi Arabia. One was a behavioral model, which attributed accident responsibility to people; the other was situational, which considered the interactions between humans, environment and the situation for studying the accident process.<sup>11</sup> Abdelhamid and Everett developed an ‘Accident Root Causes Tracing Model’, or ARCTM. It determined the causes of the unsafe condition: ‘(1) Failing to identify any unsafe condition that existed before the activity was started, or that developed after activity was started; (2) deciding to

proceed with a work activity after the worker identifies an existing unsafe condition; and (3) deciding to act unsafely regardless of the initial conditions of the work environment.<sup>12</sup>

Most of the causes relate to people and their attitudes and behavior such as some combination of inadequate supervision, education/training, or culture (e.g., lack of emphasis on adherence to rules and regulations).<sup>13</sup> The effect size of these factors can vary substantially from setting to setting and even from study to study.<sup>14-17</sup> The unavoidable but often underappreciated reality is that the relationship between safety policy and safety practices is complex, nuanced, and strongly influenced by a range of cultural variables.<sup>16</sup> It is interesting to note that Chinese opinions of influential factors are somewhat different from Saudi Arabian opinions. For example, a lack of experienced project managers and a lack of certified skill labor are much bigger concerns in Saudi Arabia.<sup>18-20</sup> This finding underscores the importance of using country- and industry-specific data to guide safety interventions and policy modifications and solutions can be developed and deployed more efficiently and effectively only after careful diagnosis of problems.<sup>21</sup> Although the impact of Saudi Arabian culture on safety practices has not yet been studied, regional surveys which have been conducted show that there is a lack of effective implementation in many settings in the Middle East, such that ‘basic safety requirements (protective eyewear and footwear or fall protection) are not often enforced’.<sup>22</sup>

A particularly useful suggestion made by SCP and Saudi Aramco is the creation of laws governing safe

construction practices but the enforcement rate of existing laws is only 25%, showing that few laws which exist are not often enforced.<sup>23</sup> The success of SCP demonstrates what can be achieved with the right attitude towards safety.<sup>24</sup>

## Conclusions

All the surveyed Saudi Arabian construction companies indicated safety concerns, as well as the importance of 25 factors related to construction site accidents. Survey results confirmed the findings of recent literature that managerial attitudes and human factors are ranked the most important safety issues. The only way to thoroughly understand the construction site accident environment for all Saudi Arabian companies is to begin keeping accurate safety records. Correspondingly, positive impacts will be seen on the bottom line. The study suggests that a change in attitudes concerning safety management practices is the key to changing the practices themselves; Every single factor listed in the survey could either be eliminated, or at least significantly reduced, with proper education, training, and safety commitment. This can be done not only by management but also by every worker. It becomes

necessary for the Saudi construction industry to develop new approaches to shaping safety behaviors by seeking to nurture a robust and proactive safety culture.

## Limitations

The survey data reflects that management's attitude and other human factors play a large role, it is important to note that the present study is preliminary and limited by its small sample size and limited Scope. Further research, ideally utilizing significantly larger samples, will be required to confirm these findings. Despite this limitation, however, the findings presented above offer an attractive starting point that could shape the design of subsequent studies on this important topic.

## Conflicts of Interest

The authors declare no conflict of interest.

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