

IDENTIFYING THE EXISTING SAFETY MANAGEMENT PRACTICES IN MICRO, SMALL AND MEDIUM CONSTRUCTION COMPANIES IN SAUDI ARABIA

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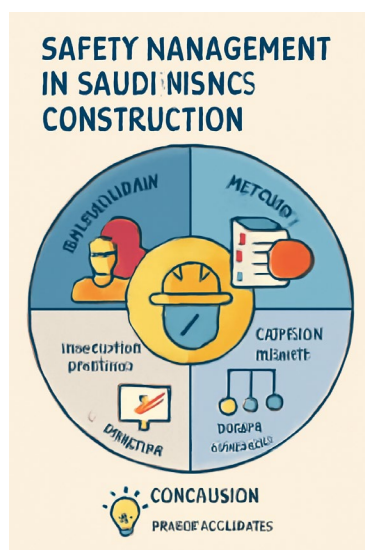
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Abstract

This study examined the existing safety management practices in micro, small, and medium-sized construction companies (MSMCs) within the Kingdom of Saudi Arabia's. This survey was necessitated due to reported high incidences of accidents causing severe havoc including injuries and fatalities during construction project delivery. A descriptive survey with a structured questionnaire as the instrument for data collection was used to assessed 13 safety management practices by 440 MSMCs purposely and conveniently selected as the respondents. The questionnaires attain 71% response rate, and data analysis was conducted with the aid of the statistical package for social science (SPSS). Findings revealed that, the major existing safety management practices implemented by MSMCs and ranked in order of importance are: Hazard identification before work, Adequate welfare on-site, Safety training for supervisors, Verbal communication with workers, Availability of Personal Protective Equipment (PPE), and Risk assessment documentation respectively. In conclusion, leveraging the use of technology including Artificial intelligence, Robotics, Augmented reality and Cyber-physical systems among other digital era technologies will go a long way in enhancing safety in construction project delivery which could possibly mitigate incidences of accidents by employees of micro, small and medium size companies in the Kingdom of Saudi Arabia.

Keywords: Accidents, Construction projects; Health; Safety management practices; Micro, small and medium companies

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1.0 INTRODUCTION

For decades, micro, small, and medium companies (MSMCs) are being recognized as critical in the socio-economic development of any nation. MSMCs assure more equitable distribution of national income and wealth. It contributes to the socio-economic development of any nation, as they are ancillaries to large manufacturing industries. For instance, MSMCs in developing countries contributes to reducing poverty and income inequality by providing employment opportunities to a large segment of neglected population. In Saudi Arabia,

MSMCs forms substantial part of its construction industry, according to Alruwaili et al. [1]. MSMCs in Saudi Arabia employs a large part of the workforce. According to Saudi Contractors Authority (SCA), 95.18% of companies are MSMCs, and Workers engaged by this companies are more likely to sustain injuries than their counterpart employed by large companies [2]. The Saudi Arabian construction sector provides significant employment opportunities for over three million workers and accounts for almost 35.7% of the country's 8.52-million human labour work force [2]. However, the sector is prone to accidents. According to statistics provided by the General Organization of Social Insurance (GOSI), Saudi Arabia's

construction industry are largely to be blamed for most site accidents due to lack of adherence to health and safety measures [2, 3].

The General Organization for Social Insurance in Saudi Arabia reported that there were 69,241 occupational accidents in the year 2014, and majority of these accidents (51.35%) occurred in the construction sector [3]. Basically, the goal of health and safety management is to protect people's personal health, including those of construction site employees and other people whose health could be negatively impacted by such activities [4]. Also, various necessary precautionary measures should be put in place and implemented to handle diverse health and safety challenges during construction project delivery.

Construction workers should be the first group to receive attention for increasing safety awareness because they are the most vulnerable and affected by incidences of hazards leading to issues including injuries and fatalities [5,3]. The underestimation of safety risks and the inadequate recognition of hazards lead to catastrophic accidents [6]. One of the biggest problems in the construction industry has always been poor adherence to Operational Health and Safety (OHS) regulatory framework. In Nigeria, according to Ali and Misnan [7] a lack of awareness and expertise among employees and contractors further exacerbates unsafe practices, as they may not fully understand the importance or proper execution of safety protocols. Cultural factors and human behaviour are significant factors influencing sustainable safety and health practices [7]. In addition, due to outdated or poorly maintained infrastructure increases the risk of accidents and environmental hazards, creating a complex environment where the effective implementation of safety and health practices remains difficult. Although the operational Health and Safety (OHS) standards are widely publicized, but, Saudi Arabia's micro, small, and medium-sized construction companies have not yet reached acceptable levels of implementation. As a result, incidences involving construction workers frequently result in serious injuries and fatalities. To create a productive environment, it is crucial to provide a safe and healthy workplace [8]. However, Aljohani [2] highlighted that, safety studies will provide the Safety Management Practices Model as a road map for MSMCs to follow when using safety practices on the workplace.

1.1 Statement of the Problem

Though, safety in Saudi Arabia were significantly improving across various sectors of the economy. However, hazards and safety issues are still of major concern in the construction industry, due to underlining factors including: Lack of training, inadequate knowledge and awareness, poor safety practices, and worker and management commitment are all significant factors that contribute to unsafe workplaces and accidents, according to [9, 1]. After extensive review, there exist evidence of significant incidences of accidents in the Saudi Arabian construction industry. Therefore, immediate action is required to reverse this negative trend, which forms the thrust of this study.

1.2 Aim Of The Study

This study assessed the existing safety management practices in micro, small and medium construction companies in Saudi Arabia.

1.3 Significance of Study

The construction sector in Saudi Arabia lacks adequate safety management standards and there exist paucity of empirical studies especially regarding MSMCs [10].

According to Saudi Contracting Authority, there were 17,299 cases of occupational injuries in the Saudi construction industry between 2015 and 2020, with a range of injury statuses including under treatment, cured, disabled, and dead [11]. This study will assist stakeholders in the construction sector, particularly MSMCs, in terms of safety management in order to reduce workplace accidents.

2.0 LITERATURE REVIEW

2.1 Incidences of Accidents in Saudi Arabia's Construction Industry

Due to inherent risk of project delivery, the construction industry has one of the highest rates of injuries and fatalities worldwide, making it one of the most dangerous industries [12]. The construction industry of Saudi Arabia is witnessing a high number of accidents compared to other industries, which is a source of great concern [13]. Scholars including, Oduoza *et al.* [14] alleged that the behavioural dimensions of the safety climate are underappreciated in smaller companies. Hence, it is highly debatable whether MSMCs have effective safety management practices.

Between 2020 to 2021, there was 1,889 occupational construction related injuries reported in Saudi Arabia [2].

2.2 Micro, Small and Medium Companies (MSMCs)

Micro, Small, and Medium Enterprises (MSMCs) form the backbone of most economies worldwide, playing a vital role in job creation, innovation, and inclusive growth. The improvement of the MSMCs sector has been the prime concern of the governments across the globe [15]. It is common believe that they contribute to poverty alleviation by creating employment opportunities for most vulnerable in the society. Apart from creator of job opportunities, the sector is also a major contributor towards the GDP of most nation [3, 9].

MSMCs have three noted "characteristics. Firstly, these companies typically contribute to a small portion of the overall construction market, indicating that they have little to no influence over prices, quantities, or the environment, though it is possible for MSMCs to have a significant impact on a niche market that is both small and highly specialized [4]. Secondly, despite varied levels of formalization across the organizations, administration of MSMCs is typically carried out in accordance with the owners' or co-owners' preferences without formal management [1]. Finally, MSMCs enjoy greater independence in decision-making because they" are not under the control of the parent company [16]. In general, regardless of the many definitions of these companies in different countries, the characteristics of such businesses remain largely the same. There characteristics can be in terms of investment, labour

intensive, number of employees, area of operation, and management.

According to the Small and Medium Enterprises General Authority, Micro, Small and Medium Enterprises (MSMCs) in Saudi Arabia are defined based on two primary criteria: annual revenue and number of employees [17]. Micro enterprises employ 1-5 workers with annual revenue up to 3 million SAR; small enterprises have 6-49 employees with revenue between

3-40 million SAR; and medium enterprises employ 50-249 workers with revenue ranging from 40-200 million SAR, with revenue being the determining factor when classifications differ between criteria [18]. The distribution of MSMCs in the Kingdom of Saudi Arabia (KSA) is dominated by Commercial/hospitality, and the Construction sector accounting for over 70% of all companies as depicted in Figure 1.

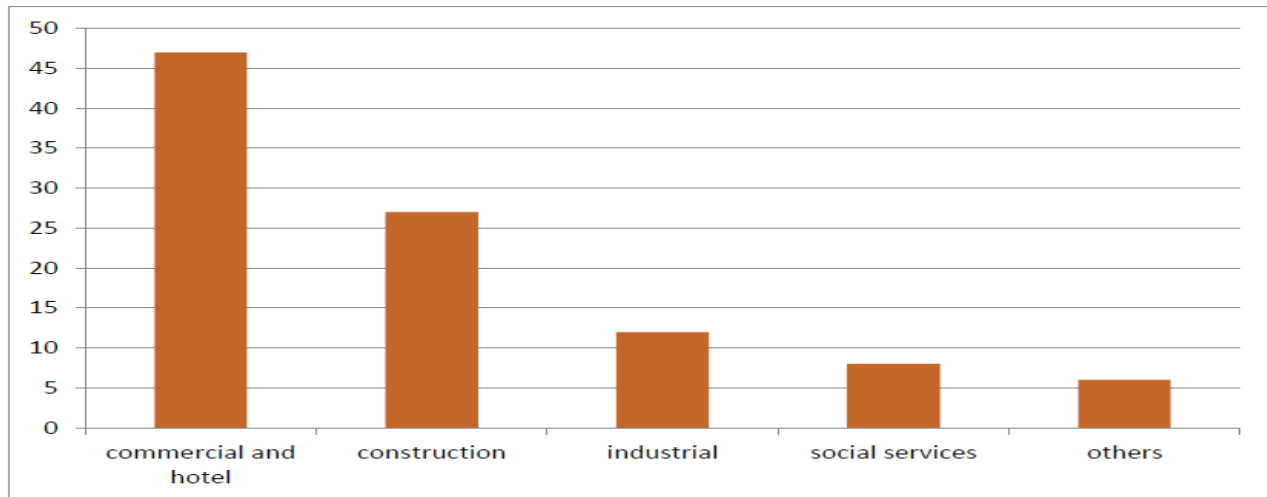


Figure 1 SMEs' sector-wise distribution in Saudi Arabia

Source: [14]

2.3 Safety Management Practices for MSMCs

2.3.1 Safety Management

Safety management is the process used to identify health and safety risks, put measures in place to lessen the likelihood that risks will materialize, and lessen or eliminate any potential consequences of those risks for the project in question [19, 20]. Processes, programs, procedures, and policies that have a relevant authority monitoring their ongoing administration, development, and implementation are included in safety management. Typically, these safety management elements are documented in writing and disseminated as authorized paperwork outlining authority, responsibility, role, and function in relation to safety [21]. In MSMCs, safety management can be particularly challenging as they often have limited resources and expertise in occupational health and safety. However, it is crucial for MSMCs to prioritize safety management to ensure the well-being of their employees and to comply with legal and regulatory requirements [22]. Through effective safety management practices, MSMCs can create a safer work environment, reduce the risk of accidents and injuries, and enhance productivity and profitability [23, 10].

2.3.2 Safety Practices

Safety practice refers to the set of actions, procedures, "and policies that are designed to promote and ensure the safety of people, property, and the environment [24, 5]. These practices are implemented in various settings, including workplaces, homes, schools, public spaces, and transportation. Safety

practices aim to prevent accidents, injuries, and illnesses by identifying potential hazards and taking steps to eliminate or control them [25]. The adoption of safety practices is critical for promoting a safe and healthy environment for individuals and communities. By implementing and adhering to safety practices, individuals can minimize the risk of harm and ensure the protection of themselves and others [26]. MSMCs are the backbone of many economies around the world. They play a significant role in creating jobs, driving innovation, and boosting economic growth. However, MSMCs face a range of challenges, including limited resources and capacity, which can impact their ability to implement effective safety practices [6]. Some ideal safety practices measures are highlighted as thus:

2.3.2.1 Worksite Analysis and Hazard Assessment

Worksite analysis forms a crucial component of safety management practices, involving systematic evaluation of all workplace activities for potential health and safety risks [14]. This process includes continuous reassessment of workplace activities when operational changes occur, identification of existing hazards during site inspections, and implementation of preventive measures [15]. A comprehensive worksite analysis system requires establishing proper reporting mechanisms for employees to report hazardous conditions, and thorough investigation of all accidents and near-misses to determine root causes [27]. The analysis extends to evaluation of equipment, machines, and materials used on site, ensuring all components meet safety standards and requirements.

2.3.2.2 Training and Control Measures

Safety training and control measures represent essential elements in MSMC safety management practices [13]. Training programs must address both health and safety aspects, incorporating various delivery methods including printed instructions, video demonstrations, PowerPoint presentations, and interactive tools [28]. The effectiveness of training programs can be evaluated through surveys, pre and post-tests, and observational assessments. Control measures follow the hierarchy of control principle, which includes:

- i. Hazard elimination from the site
- ii. Hazard substitution
- iii. Implementation of engineering controls (guardrails, alarm systems)
- iv. Administrative control measures
- v. Provision and proper use of Personal Protective Equipment (PPE)

The integration of these training and control measures ensures a comprehensive approach to safety management, helping MSMCs create safer work environments and reduce workplace accidents and injuries [17]. A safety program must include training addressing health and safety. Planning, program development using printed instructions, video, demonstrative, power point, and interactive tools, program delivery using lectures, and training output evaluations using surveys, post-tests, and pretest observations are all components of an efficient and effective training program [21]. Three stages of evaluation are possible: trainee learning assessment, learning measurement, and safety performance indicator [29]. These approaches will improve safety management practices by MSMCs.

2.3.2.3 Personnel Safety Responsibilities

Construction sector is be devilled with risks and accidents whereby the obligations and commitments to safety management in companies are often the responsibility of the by clients or the few other available managers who have many other duties and tasks to perform [23]. It is common practice to assign personnel to oversee all aspect of safety and health of employees and others within the construction site. The main officer responsible for this job are Safety and Health Officer (SHO) or Site Safety Supervisor (SSS) and safety Committee. The responsibilities and functions of these officers and committees are discussed in the following sub sections [6].

Depending on the size of the company and their activities, a Site Safety Supervisor may be engaged as part time or full-time staff. It is precondition that he or she will have requisite experience in the areas of construction activities and knowledge in health and safety education. Some of the main duties of SSS are; running safety checks, encouraging safe practices in the company; educating and correcting harmful and dangerous practices among staff [14].

2.3.2.4 Deployment Of Emergent Technologies

a. Artificial Intelligence Applications

Research increasingly highlights the transformative role of artificial intelligence (AI) in enhancing safety management across industries. Alruwaili et al. [1] underscore the potential of predictive risk analysis powered by AI. The

study demonstrates how machine learning algorithms can analyse extensive historical data to identify patterns and trends associated with workplace hazards. By anticipating potential risks, organizations can implement targeted preventive measures, significantly reducing the likelihood of accidents and enhancing overall safety outcomes. Building on this, Oduoza et al. [14] document AI's effectiveness in real-time safety monitoring. The research emphasizes the capabilities of advanced computer vision systems in detecting safety protocol violations, such as the improper use or absence of personal protective equipment (PPE). These AI-driven systems provide instantaneous alerts, ensuring that corrective actions are taken promptly to mitigate risks. Collectively, these studies highlight [24] AI's pivotal role in predictive and real-time safety management, offering innovative solutions that enhance workplace safety and operational efficiency.

b. Internet of Things (IoT) Innovations

The Internet of Things (IoT) has introduced sophisticated safety monitoring mechanisms that are transforming workplace safety and operational efficiency. Chen et al. [30] provided a detailed account of the growing adoption of smart wearable devices equipped with IoT technologies. These devices monitor vital signs such as heart rate, body temperature, and stress levels, while simultaneously tracking environmental factors like air quality, temperature, and noise levels. By delivering real-time data, these wearables enable proactive interventions to safeguard worker health and prevent accidents in dynamic and hazardous environments. In parallel, Singh et al. [31] explored IoT's capacity to enhance predictive equipment maintenance, a critical aspect of industrial safety. The research highlights how IoT-enabled sensors facilitate continuous monitoring of machinery, identifying early signs of wear or malfunction. This predictive approach minimizes unexpected equipment failures, reduces downtime, and significantly lowers the risk of accidents arising from mechanical breakdowns [20]. Together, these advancements underscore IoT's pivotal role in fostering safer, more responsive workplaces through real-time monitoring and predictive analytics.

c. Augmented and Virtual Reality Developments

Immersive technologies, encompassing virtual reality (VR) and augmented reality (AR), have revolutionized training and risk assessment practices across various industries. These cutting-edge tools offer unparalleled opportunities to simulate, analyze, and respond to complex scenarios in controlled environments [9]. Hannah et al. [32] conducted an extensive study on VR's capacity to generate realistic safety simulations, demonstrating how workers can be immersed in hazardous scenarios without exposure to physical risks. The research highlights VR's ability to enhance hazard recognition and emergency response training, ultimately improving workplace safety and preparedness. Meanwhile, Ginés and Velazquez [33] focused on the transformative role of AR in safety and operational contexts. The findings underscore AR's potential to deliver real-time safety instructions and

facilitate remote expert guidance. By overlaying critical information directly onto a user's field of view, AR ensures that complex procedures and immediate hazards are clearly communicated, thereby reducing human error and improving decision-making in high-stakes situations [4]. Together, these studies emphasize the significant contributions of immersive technologies to fostering safer and more efficient work environments.

2.4 Safety Management Policy Implementation

Management commitment is fundamental to establishing effective safety management practices in MSMCs. From the onset, the management needs to develop or adopt a safety policy. This safety policy should at least be made to suit the needs of the work place and be regularly updated so that it can help in promoting an effective and safety management system [34]. This commitment begins with the development and clear communication of health and safety policies to all employees. Management responsibilities encompass: instilling safety responsibility throughout the organization, ensuring compliance with safety regulations, reviewing accident reports, conducting regular safety meetings, and fostering engagement between workforce staff and management in safety-related activities [25]. Also, it includes; the allocation of specific duties for safety operations, provision of necessary resources to achieve safety goals, integration of safety protocols into company procedures, and implementation of reward systems for safe behaviour compliance [35]. The success of any safety management practices largely depends on management's active involvement and dedication to creating a safety-conscious work environment [20]. A typical policy should have the following:

- i. Show the involvement of top management and other stake holders in the development of the policy document
- ii. It must be relevant to the workplace regardless of whether it was adopted or developed
- iii. It must be a key policy among other companies 'policies: The policy statement must show a clear a direction, responsibilities of all personnel, commitment to regular reviews, accountability of all levels of management, and future plans for occupational health and safety of the company.
- iv. Accountability and responsibility should be of utmost importance in the development of the policy.
- v. The adopted policy must be effectively communicated: The policy must be clearly defined, infused to daily activities of the company, well monitored. The employees should be trained, backed up with well-developed reference manuals, health safety committees and meetings. Furthermore, the top management must demonstrate commitment through reviews, inspection reports, incident investigations

2.5 Conceptual Model

Figure 2 is the conceptual model developed for this study and it has four (4) major influencing variables. *Safety Policies and Programs*: has factors 'Adequate safety policies, Written safety programs, Safety policy visibly displayed'. *Legal and Operational Compliance*: has factors 'Labor certificate for contracts, Risk assessment documentation, and Hazard identification before work'. *Safety Equipment and Site Conditions*: has factors 'Availability of Personal Protective Equipment (PPE), and Adequate welfare on-site'. *Training and Communication*: Site inductions, Safety training for supervisors, Verbal communication with workers, Safety meetings, and Safety posters and orientation.

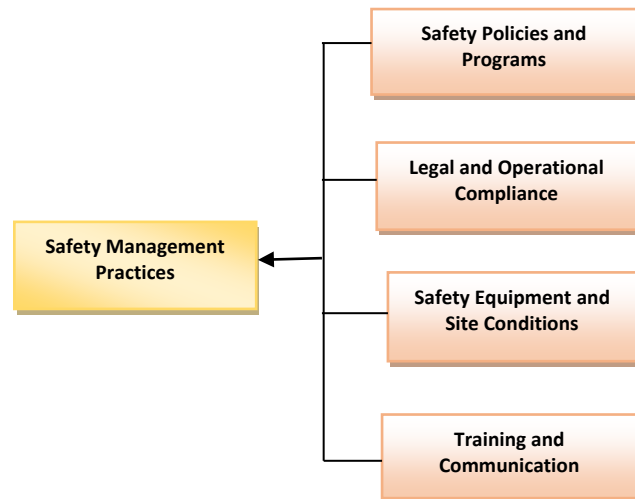


Figure 2 Conceptual Model of the study
Source: compiled by Author's

3.0 METHODOLOGY

Assessing the existing safety management practices among micro, small, and medium construction companies (MSMCs) in Saudi Arabia is the scope of this study. A descriptive survey with a structured questionnaire as the instrument for data collection was adapted for this study. This methodology was used by scholars including [36] and [37] in their studies respectively. The 5-point Likert scale questionnaire with 1 being the least and 5 being the highest focused on capturing MSMCs perspectives regarding current safety practices, which are grouped as thus: Safety Policies and Programs, Legal and Operational Compliance, Safety Equipment and Site Conditions, and Training and Communication. A total of 440 MSMCs contractors and safety professionals engaged in residential and commercial building construction, infrastructure development, and civil engineering works were selected using a purposive and convenience sampling technique as the study's respondent, this approach was used by scholars in similar studies, for instance [7] and [38] respectively. The questionnaires attain 71% response rate, and data analysis was conducted with the aid of the statistical package for social science (SPSS). According to Shehu et al. [39], the SPSS is being the most widely used tool because it is easy to operate and present data in various forms. The results were presented

through the use of tables, percentages, mean item score, and standard deviation.

Figure 3 show the summary of research methodology

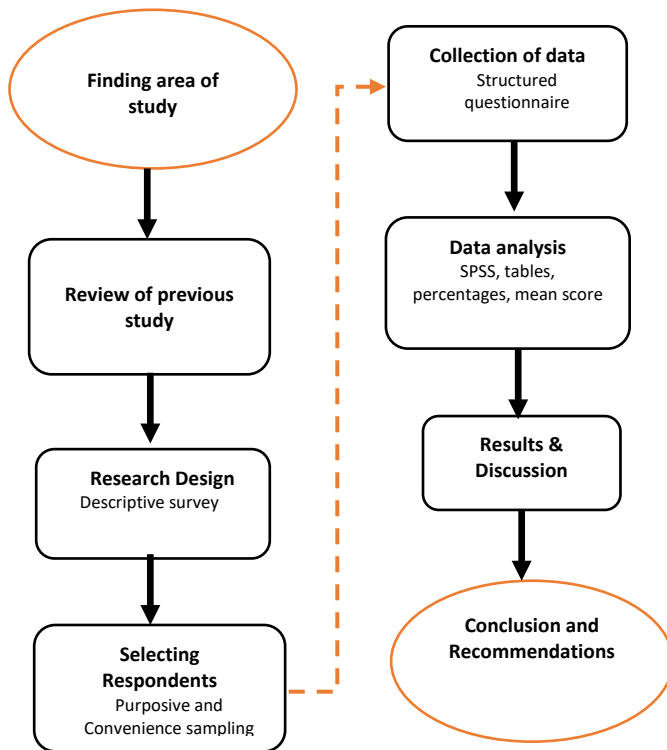


Figure 3 Summary of Research Methodology
Source: Adapted: Umar et al. [40] [41]

4.0 RESULTS AND DISCUSSIONS

This section presents the results from the analysis of the existing safety management practices implemented by micro, small, and medium construction companies (MSMCs) in Saudi Arabia as presented in Table 1. Findings revealed that, the major safety management practices implemented by MSMCs and ranked in order of importance are: Hazard identification before work (Mean Score 3.93 & Standard Deviation 1.91); Adequate welfare on-site (MS 3.70 & SD 1.94); Safety training for supervisors (MS 3.69 & SD 1.78); Verbal communication with workers (MS 3.60 & SD 1.98); Availability of Personal Protective Equipment (PPE) (MS 3.54 & SD 1.85); and Risk assessment documentation (MS 3.50 & SD 1.51) respectively.

Table 1 Safety management practices implemented by construction companies (MSMCs) in Saudi Arabia

Variables	Mean Score	Std. Dev.	Ranked
Adequate safety policies	3.33	1.64	10
Written safety programs	3.28	1.55	11
Safety policy visibly displayed	3.43	1.70	7
Labor certificate for contracts	3.21	2.10	12
Risk assessment documentation	3.50	1.51	6
Hazard identification before work	3.93	1.91	1
Availability of Personal Protective	3.54	1.85	5

Equipment (PPE)			
Adequate welfare on-site	3.70	1.94	2
Site inductions	3.43	1.73	7
Safety training for supervisors	3.69	1.78	3
Verbal communication with workers	3.60	1.98	4
Safety meetings	3.34	1.86	9
Safety posters and orientation	3.18	2.00	13

4.1 Discussion Of Findings

The analysis of existing safety management practices among micro, small, and medium construction companies (MSMCs) in Saudi Arabia revealed a moderate to good level of implementation across several key areas. The findings indicate that many companies possess basic safety policies and written safety programs, with mean scores of 3.33 and 3.28 respectively. Notably, the visibility of safety policies on-site scored slightly higher (3.43), suggesting that while policies may not always be well-documented or deeply integrated, there is an effort to display safety commitments to workers and stakeholders. These assertions were corroborated by Ali and Misnan [7] in their studies respectively.

This pattern indicates a partial internalization of safety culture, where symbolic compliance may precede operational effectiveness. In terms of legal and operational compliance, practices such as labor certification for contracts (mean: 3.21), risk assessment documentation (3.50), and hazard identification before work commences (3.93) were assessed. The high score for hazard identification suggests a proactive approach toward identifying risks before initiating tasks, which is a commendable practice. However, the lower score for labour certificate compliance implies that formal regulatory adherence remains inconsistent, possibly due to the informal employment practices often found in MSMCs. These findings align with scholars including [7].

Provision of Personal Protective Equipment (PPE) and welfare facilities on construction sites was also evaluated. PPE availability scored a mean of 3.54, and adequate welfare provisions scored 3.70, reflecting that basic physical safety needs and worker welfare are generally well met. This supports the notion that MSMCs, despite financial and administrative limitations, prioritize direct interventions like PPE over procedural or policy-driven strategies.

Training and communication practices demonstrated a mixed level of implementation. Site inductions (3.43) and safety training for supervisors (3.69) were fairly well-integrated, indicating that MSMCs recognize the importance of preparing personnel for onsite safety expectations. Verbal communication with workers (3.60) and safety meetings (3.34) are also common, underscoring the reliance on oral briefings due to the low literacy levels or language barriers often present in the construction workforce. However, the use of visual safety materials such as posters and orientations received a lower mean score of 3.18, suggesting an underutilization of passive safety communication tools that could support broader safety awareness, especially in multicultural environments. Adebisi et al. [42] offered earlier evidence on the vital role of comprehensive training in enhancing workers' safety behavior. Also, Scholars including [43], and [39] highlighted that the effectiveness of communication in promoting safety during

construction project delivery largely depends on the methods used.

5.0 CONCLUSION

Assessing the existing safety management practices in micro, small and medium construction companies in Saudi Arabia is the thrust of this survey. The major safety management practices implemented by MSMCs in the Kingdom of Saudi Arabia construction industry are: Hazard identification before work, Adequate welfare on-site, Safety training for supervisors, Verbal communication with workers, Availability of Personal Protective Equipment (PPE), and Risk assessment documentation respectively. The study recommends leveraging the use of technology including Artificial intelligence, Robotics, Augmented reality and Cyber-physical systems among other digital era technologies will go a long way in enhancing safety in construction project delivery which could possibly mitigate incidences of accidents by employees of micro, small and medium size companies in the Kingdom of Saudi Arabia.

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Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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