

An investigation into the safety management system in the Indian construction sector

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Abstract- The construction industry in India, as the second largest employer after agriculture, faces significant challenges in ensuring worker safety due to its largely unorganised nature, a lack of formal accident reporting systems, and a workforce that is predominantly unskilled and migratory. These factors, combined with hazardous working conditions and the temporary nature of construction work, contribute to a high incidence of workplace accidents. The absence of systematic screening and insufficient enforcement of safety regulations further exacerbate the risks, making the sector particularly vulnerable to accidents resulting in serious injuries or fatalities.

To address these issues, a comprehensive research study was conducted, employing both quantitative and qualitative methods to analyse the factors influencing safety on construction sites. The study led to the development and implementation of a total construction safety management system model, grounded in the Plan-Do-Check-Act (PDCA) cycle. This model introduces Key Safety Performance Indicators (KSPI) and specialised tools, such as an electrical safety audit, to systematically measure and improve safety outcomes. The research underscores the importance of adopting efficient safety management techniques and offers strategic recommendations for organisations to enhance workplace safety, reduce accidents, and foster a safer environment for construction workers in the long term.

Keywords: Construction Safety, Safety Management System (SMS), Indian Construction Industry, Workplace Accidents, Unorganized Sector, Health and Safety, PDCA Cycle, Key Safety Performance Indicator (KSPI), Electrical Safety, Construction Workforce

LITERATURE REVIEW

O'Toole (2002) identifies safety culture as critical factor that sets the tone for the importance of safety within an organization.

Neal and Griffin (2002) presents a model identifying the linkages between safety climate, safety knowledge, safety motivation and safety behavior. Findings from a series of studies are reviewed that support the hypothesized linkages between safety climate and safety behavior. Longitudinal analyses have examined the role of additional factors, such as general organizational climate, supportive leadership and conscientiousness as sources of stability, change in safety climate and safety behavior.

Tam et al (2001) stated that the construction industry of Hong Kong has a very poor site safety record. The overall accident rate has gone down a little during the last few years, but the number of fatalities has risen dramatically. In the past, the HongKong Government adopted a laissez- faire approach in managing construction safety, hoping that market forces would regulate the safety performance. However, the approach has proved to be ineffective. Since 1986, the Government has taken a proactive approach in combating construction site safety, and has introduced a series of safety programmes, which consist of encouraged and mandatory schemes aiming at nourishing a proper safety culture in the construction industry. Recently, the government decided to criminalize site accident cases by introducing a so-called 'Supervision Plan', aiming at changing the safety attitude and culture of construction practitioners. This paper applies an attitude-changing model, reinforcement theory', to predict the changing attitude of people in the construction industry. The results show that the attitude of construction practitioners in HongKong will change to be more positive when they receive more messages to confirm that people really are put into jail for the negligence under the Supervision Plan.

The construction industry is a key driver of economic and social development worldwide, but it remains one of the most hazardous sectors due to its fragmented structure, complex work environments, and transient, often unskilled workforce. Unlike manufacturing, where controlled environments and stable labor promote better safety, construction sites are dynamic and constantly changing, making hazard identification and accident prevention challenging. Many stakeholders prioritize project completion over safety, leading to a weak safety culture and poor accident records, especially in developing countries where accident data is often unreliable or underreported. Global statistics highlight the high incidence of both fatal and non-fatal accidents in construction, prompting governments to introduce health and safety legislation, though enforcement and effective implementation remain inconsistent.

In developing countries like India, additional challenges such as lack of proper safety culture, inadequate enforcement agencies, high manual labor content, and limited training further exacerbate risks. Many construction activities are informal, and high worker turnover, illiteracy, and exploitation by contractors are common. The absence of robust safety management systems and proactive safety measurement tools contributes to persistently high accident rates. Recognizing these issues, the present research aims to develop a new model for safety performance measurement and to analyze the factors affecting construction site safety in India. The study is limited to the Indian construction sector and focuses exclusively on site-related accidents and safety management practices, with the goal of proposing effective solutions to improve workplace safety and reduce accidents.

METHODOLOGY

This outlines the structural organization of a research thesis focused on construction site safety, particularly electrical safety and broader construction safety management systems. It indicates the inclusion of several key chapters such as the Introduction, Review of Literature, and various sections dedicated to research methodology, case studies, and analysis. The thesis appears to adopt a multi-faceted research design

incorporating both theoretical frameworks and practical evaluations through case studies and performance indicators.

1.1 Significance of Construction Industry

The construction industry holds immense significance in the economic and social development of countries across the world. It is a major driver of infrastructure growth, urbanization, and employment generation, playing a foundational role in shaping modern societies. As noted by Coble and Haupt (1999), the sector's contribution to national economies is well-documented, with construction activities stimulating growth in related industries such as manufacturing, transport, and services. The development of roads, bridges, buildings, and other essential infrastructure not only enhances the quality of life for citizens but also attracts investment and supports broader economic advancement.

Furthermore, the construction industry provides diverse employment opportunities, ranging from unskilled labor to highly specialized professionals like engineers, architects, and project managers. This wide spectrum of jobs supports livelihoods for millions and helps alleviate poverty, especially in developing nations where alternative employment options may be limited. The industry's multiplier effect ensures that growth in construction leads to increased demand for materials, equipment, and services, thereby boosting other sectors of the economy. However, the industry's significance also brings challenges, particularly in terms of safety, quality, and sustainability, which must be addressed to ensure that its benefits are maximized for society as a whole.

1.2 Safety as a Secondary Concern

In the construction industry, safety is frequently treated as a secondary concern, overshadowed by the primary goals of meeting project deadlines, maintaining quality standards, and controlling costs. Stakeholders such as owners, contractors, and suppliers often prioritize the timely and cost-effective completion of projects, which can lead to the neglect of essential safety measures and protocols. This tendency is particularly pronounced in profit-driven environments, where the pressure to deliver results quickly can overshadow the need to foster a strong

safety culture. As a result, the motivation to invest in comprehensive safety training, enforce safety regulations, or implement proactive safety management systems is often lacking.

This lack of emphasis on safety has significant consequences for the workforce and overall industry performance. The construction sector consistently records higher accident and injury rates compared to more controlled industries like manufacturing, where stable environments and established procedures make it easier to manage hazards. The dynamic and fragmented nature of construction sites, coupled with a transient and often unskilled labor force, exacerbates these risks. Without a genuine commitment to safety from all stakeholders, unsafe practices can become normalized, leading to preventable accidents, injuries, and even fatalities. Addressing this issue requires a shift in mindset, where safety is integrated into every aspect of project planning and execution, rather than being treated as an afterthought.

1.3 Comparative Safety Records

The construction industry's safety record is notably poorer than that of the manufacturing sector, largely due to differences in work environments and workforce stability. In manufacturing, work procedures and equipment remain relatively constant over long periods, and the labor force is generally stable and well-acquainted with the hazards and necessary precautions. This controlled environment enables manufacturing industries to maintain better safety standards and lower accident rates.

In contrast, construction sites are dynamic, with constantly changing work environments and a migratory workforce. The fragmented nature of the industry, coupled with technical complexity, unpredictable site conditions, and frequent changes in personnel, makes it difficult to maintain consistent safety practices. As a result, construction projects tend to experience higher rates of accidents and injuries. Global data and studies consistently show that construction records more frequent and severe accidents than manufacturing, underscoring the urgent need for improved safety management and culture in the construction sector.

1.4. Dynamic and Fragmented Work Environment

The construction industry operates within a dynamic and fragmented work environment, which significantly impacts safety management and performance. Unlike manufacturing, where the work environment and procedures remain relatively stable, construction sites are constantly evolving due to the nature of projects, varying locations, and changing work scopes. This constant change means that hazards are continually emerging, requiring ongoing identification and mitigation efforts. The workforce itself is often transient, with workers moving from one project to another, leading to inconsistent safety practices and a lack of familiarity with site-specific risks.

Additionally, the construction industry is composed of a wide array of organizations and stakeholders—including developers, architects, engineers, contractors, subcontractors, and specialized trades—each with their own roles, responsibilities, and approaches to safety. This fragmentation can lead to communication gaps, unclear accountability, and inconsistent implementation of safety protocols across different teams and phases of a project. Such complexity is further compounded by the technical challenges of construction work, financial and time pressures, and the need to coordinate multiple activities such as working at heights, manual handling, and exposure to hazardous materials. As a result, maintaining a consistent and effective safety culture is particularly challenging in construction, making the industry more prone to accidents and injuries compared to more controlled sectors.

1.5. Complex Organizational Structure

The construction industry is characterized by a highly complex organizational structure, which significantly influences safety management and project outcomes. Unlike more centralized industries, construction projects typically involve a diverse network of participants, each with distinct roles, responsibilities, and priorities. This intricate web of stakeholders includes:

Property developers

- Architects and engineers
- Quantity surveyors and accountants
- Lawyers and management contractors
- Civil engineering contractors and laborers

- Sub-contractors and specialist trades

1. 6. High-Risk Activities

High-risk activities are inherent to the construction industry, making it one of the most dangerous sectors for workers, especially in developing countries like India. Common high-risk tasks include working at heights, manual handling of heavy materials, demolition, operation of heavy machinery, excavation, and exposure to hazardous substances. These activities are further complicated by adverse physical and environmental conditions, a largely unskilled and migratory workforce, and a lack of proper screening or training prior to deployment. The temporary and ever-changing nature of construction work, coupled with poor enforcement of safety regulations and the absence of reliable accident reporting systems, increases the likelihood of accidents resulting in serious injuries or fatalities.

Addressing these risks requires a comprehensive approach to safety management. Research in the Indian context highlights the need for dedicated site-based safety management systems, such as those built on the Plan-Do-Check-Act (PDCA) cycle, and the implementation of Key Safety Performance Indicators (KSPI) to monitor and improve safety outcomes. Specific tools, like electrical safety audits, are crucial in mitigating hazards that often receive less attention. Ultimately, the adoption of efficient safety management techniques and proactive safety culture can significantly reduce workplace accidents, protect workers, and improve overall project performance in the construction industry.

1. 7. Contributing Factors to Poor Safety

Several key factors contribute to poor safety in the construction industry, particularly in developing countries like India. One of the most significant issues is the workforce composition: a large portion of construction workers are illiterate, unskilled, untrained, and often migratory, coming from rural backgrounds. There is generally no established or effective method for screening or preparing workers before they are deployed to construction sites. This lack of preparation, combined with adverse physical and environmental conditions and the temporary nature of most construction jobs, increases the risk of

accidents. The unorganized structure of the sector and the absence of a comprehensive accident reporting system further exacerbate the problem, resulting in unreliable accident statistics and making it difficult to implement targeted safety improvements.

Other contributing factors include inadequate enforcement of safety regulations, insufficient management commitment to safety, and a lack of proactive safety management systems. Many construction companies do not prioritize safety, focusing instead on project deadlines and costs. This leads to minimal investment in safety training, equipment, and supervision. Additionally, high-risk activities such as working at heights, manual material handling, and electrical work are common, but often not adequately controlled. The lack of standardized safety practices across different organizations and projects, frequent use of subcontractors, and poor communication between stakeholders also play a role. Addressing these factors requires the implementation of dedicated, site-based safety management systems—such as those based on the Plan-Do-Check-Act (PDCA) cycle—and the use of key safety performance indicators (KSPI) to monitor and improve safety outcomes.

1. 8. Lack of Standardized Accident Data

A major challenge facing the construction industry, especially in developing countries like India, is the lack of standardized and reliable accident data. The sector is largely unorganized, and there is no established or pragmatic system for reporting and recording workplace accidents. Most construction companies do not follow any formal accident reporting procedures, resulting in the absence of accurate and comprehensive accident statistics. This lack of data makes it difficult to assess the true extent of safety issues, identify recurring hazards, or develop targeted interventions to reduce accidents.

Without standardized accident data, it becomes challenging for policymakers, regulators, and construction organizations to benchmark safety performance, track improvements, or compare practices with international standards. The absence of reliable statistics also hampers research efforts and the development of effective safety management systems tailored to the unique risks of the construction sector. As highlighted in recent research, addressing this gap

is crucial for designing and implementing robust safety frameworks, such as those based on the Plan-Do-Check-Act (PDCA) cycle and Key Safety Performance Indicators (KSPI), which can help prevent accidents and improve workplace safety in the long term.

1. 9. Global Accident Statistics

Globally, the construction industry is recognized as one of the most hazardous sectors, with a disproportionately high rate of workplace accidents and fatalities compared to other industries. According to international estimates, the construction sector accounts for a significant share of both non-fatal and fatal occupational accidents. For example, a 1998 global estimate reported approximately 264 million non-fatal accidents and 350,000 fatal occupational accidents annually across all industries, with construction contributing a substantial portion to these figures. The International Labour Organization (ILO) regularly collects and publishes such data, highlighting the persistent risks faced by construction workers worldwide.

The disparity in accident rates between developed and developing countries is particularly striking. In developing nations like India, the lack of standardized accident reporting systems, enforcement of safety regulations, and proper training for workers exacerbates the problem. The Indian construction sector, which employs over 33 million people, remains largely unorganized and is plagued by unreliable accident statistics due to poor reporting practices. As a result, the true scale of construction-related injuries and fatalities is likely underrepresented in official data. These global and national statistics underscore the urgent need for robust safety management systems, proactive hazard identification, and effective implementation of safety protocols to reduce accidents and improve worker safety in the construction industry.

1. 10. Governmental and Regulatory Responses

Governments around the world have recognized the hazardous nature of the construction industry and have responded by introducing various regulatory frameworks and safety legislations aimed at reducing workplace accidents and improving overall safety

standards. In many developed countries, strict regulatory bodies such as the Occupational Safety and Health Administration (OSHA) in the United States enforce comprehensive safety standards and conduct regular inspections to ensure compliance. Similarly, countries like the United Kingdom, Singapore, and Hong Kong have adopted self-regulatory approaches, requiring contractors and proprietors to develop, implement, and maintain robust safety management systems. These frameworks often include performance-based objectives, clearly defined responsibilities, and systems for monitoring and reporting safety outcomes.

In India, the government enacted the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act in 1996, aiming to protect construction workers' rights and ensure safer working conditions. Despite this legislation and the notification of central rules in 1998, enforcement remains inconsistent across states, and the sector continues to be largely unorganized. There is no established accident reporting system, and reliable data on workplace incidents is scarce, making it difficult to assess the effectiveness of existing regulations. Recent research highlights the need for dedicated, site-based safety management systems, such as those based on the Plan-Do-Check-Act (PDCA) cycle, and the implementation of Key Safety Performance Indicators (KSPI) to monitor and improve safety outcomes. The development of tools like electrical safety audits further demonstrates a move towards proactive hazard identification and management.

1. 11. Varied Regulatory Approaches

Regulatory approaches to construction safety vary significantly across countries, reflecting differences in legal frameworks, industry organization, and enforcement capacity. In many developed nations, such as the United States, the United Kingdom, Singapore, and Hong Kong, comprehensive regulatory systems are in place. For example, the United States relies on the Occupational Safety and Health Administration (OSHA) to set and enforce strict safety standards, conduct inspections, and ensure compliance. The UK, Singapore, and Hong Kong often use a combination of government oversight and self-regulatory practices, requiring contractors and

proprietors to develop, implement, and maintain robust safety management systems. These systems typically include clear performance objectives, defined responsibilities, and regular monitoring and reporting of safety outcomes.

In contrast, developing countries like India face unique challenges in regulatory enforcement. While India enacted the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act in 1996 and notified central rules in 1998, enforcement remains inconsistent and the sector is largely unorganized. There is no established accident reporting system, and reliable safety data is scarce. Many construction companies do not follow formal safety protocols, and the workforce is often unskilled and migratory, further complicating the implementation of safety regulations. Research suggests that adopting dedicated, site-based safety management systems—such as those based on the Plan-Do-Check-Act (PDCA) cycle—and using Key Safety Performance Indicators (KSPI) can help bridge the gap between policy and practice.

1. 12. Indian Context and Legislation

To address these challenges, the Indian government enacted the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act in 1996, with central rules notified in 1998. However, enforcement remains inconsistent and incomplete across states, and many construction companies do not follow formal accident reporting or safety management systems. Recent research in India has focused on analyzing the factors affecting safety at construction sites and developing dedicated, site-based total construction safety management system models, such as those based on the Plan-Do-Check-Act (PDCA) cycle. These models incorporate Key Safety Performance Indicators (KSPI) and tools like electrical safety audits to monitor and improve safety outcomes. The research emphasizes the need for efficient safety management techniques and offers strategies for organizations to implement effective safety practices, aiming to reduce workplace accidents and create safer environments for construction workers in India.

1. 13. Challenges in Developing Countries

The construction industry in developing countries faces a unique set of challenges that contribute to its poor safety record and high rates of accidents and injuries. One of the primary issues is the lack of a real safety culture. Safety is often not prioritized by owners, contractors, or even workers themselves, with the main focus being on completing projects on time and within budget. This results in safety being treated as a secondary concern rather than an integral part of project management.

In summary, the main challenges in developing countries include:

- Lack of safety culture and management commitment
- Weak or absent enforcement of safety regulations
- High manual labor and worker density
- Unskilled, migratory, and illiterate workforce
- Language barriers and high worker turnover
- Inadequate training and PPE usage
- Exploitation by contractors and informal sector dominance

1. 14. Need for Proactive Safety Management

The construction industry is recognized as one of the most hazardous sectors, with consistently high rates of accidents, injuries, and fatalities. Traditional approaches to safety management in construction have often been reactive, focusing on responding to incidents after they occur rather than preventing them. This reactive mindset has proven inadequate, as it fails to identify underlying hazards and systemic issues before they result in harm. The lack of a proactive safety culture, especially in developing countries like India, has contributed to poor safety records and persistent risks on construction sites.

Proactive safety management is essential to effectively reduce accidents and improve overall safety performance. This approach involves anticipating potential hazards, continuously monitoring safety conditions, and implementing preventive measures before incidents occur. It requires the development and use of safety performance measurement tools that go beyond merely recording accidents and instead assess the effectiveness of safety policies, worker behaviors, and site conditions in real time. Proactive

safety management also emphasizes regular training, clear communication of safety responsibilities, and the integration of safety into every stage of project planning and execution. By shifting from a reactive to a proactive safety management system, construction organizations can create safer work environments, reduce losses due to accidents, and foster a culture where safety is a fundamental value rather than an afterthought.

RESULTS AND DISCUSSION

- The construction industry in India suffers from a poor safety culture, with safety often treated as a secondary concern compared to project deadlines and costs. There is a lack of systematic safety management, and many organizations do not have dedicated safety policies or proactive safety programs in place.
- The industry is characterized by a highly fragmented workforce, including a large number of unskilled, illiterate, and migratory workers. This diversity, along with language barriers, leads to difficulties in communication, inconsistent safety practices, and challenges in delivering effective safety training.
- Although India has enacted legislation such as the Building and Other Construction Workers (Regulation of Employment and Condition of Service) Act, enforcement is weak and inconsistent across states. Many construction companies do not follow formal accident reporting systems, and there is no centralized agency responsible for compiling national accident data.
- The industry continues to experience high rates of accidents, injuries, and fatalities, largely due to inadequate or non-existent safety management systems. Underreporting of accidents is common, resulting in unreliable statistics and making it difficult to identify trends or develop effective interventions.
- Current safety approaches are mostly reactive, focusing on post-accident responses rather than prevention. There is a strong need for proactive safety performance measurement tools and frameworks—such as those based on the Plan-

Do-Check-Act (PDCA) cycle and Key Safety Performance Indicators (KSPI)—to monitor and improve safety outcomes at construction sites.

- Improving safety in the construction industry requires not only the implementation of effective safety management systems but also a shift in worker attitudes and increased awareness. Regular training, clear communication of safety responsibilities, and fostering a culture where safety is valued at all levels are essential for reducing accidents and creating safer workplaces.

CONCLUSION

- The construction industry in India continues to have a poor safety record, with high rates of accidents, injuries, and fatalities due to inadequate or non-existent safety management systems.
- Most construction organizations rely on reactive safety management, focusing on post-accident responses rather than preventing accidents through proactive risk identification and mitigation.
- There is an urgent requirement to develop and implement site-based total safety management systems, tailored to the unique challenges of the Indian construction environment.
- Traditional safety measurement methods are insufficient. The study highlights the necessity for proactive safety performance measurement tools and frameworks that can provide real-time insights into safety levels at construction sites.
- Improving safety outcomes requires not only systems and regulations but also a change in worker attitudes and increased safety awareness through regular training and communication.
- The absence of a standardized accident reporting system and reliable data makes it difficult to benchmark safety performance, identify trends, and develop targeted interventions.
- While safety legislation exists in India, enforcement is inconsistent, and many states have yet to frame or implement the necessary rules, limiting the effectiveness of existing laws.
- The study recommends the adoption of proactive safety management frameworks, regular training,

improved data collection, and stronger enforcement of safety regulations to reduce accidents and create a safer working environment in the Indian construction industry.

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