A Study on Human Behavior and its impact on construction

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Abstract: It is one of the largest industrial sectors in the world economy and one of the occupational accident deathliest industries in the world in terms of the number of occupational accidents caused by unsafe human behaviours. This study is aimed at understanding the influence of human behavior on safety in construction sites and identifying the various factors influencing accidents and their severity on the construction sites including behavioral, psychological, physical and environmental factors. Descriptive and an analytical research design was used, and structured questionnaires, interviews and site observations were employed to collect the data, which comprised 400 respondents comprising of construction workers, site supervisors, safety officers and project managers. The data collected were analyzed using percentage analysis, descriptive statistics, correlation analysis and regression analysis using SPSS and microsoft office excel. The results demonstrate that unsafe behaviors are the most important factor affecting construction accidents; lack of safety awareness, fatigue, and job stress are the next most important factors. The study results highlight a high potential for reducing accidents on construction projects and enhancing overall project performance through increased safety awareness among workers, improvements in behavioral safety management, increased training frequency, reduction of occupational stress and fatigue and the use of contemporary technologies such as artificial intelligence and behaviour monitoring systems.

Keywords: Human behaviour, Construction safety, Behavioral safety, Artificial intelligence, Safety compliance.

1. INTRODUCTION

The construction sector has the second largest market size at 10 trillion USD, making it the oldest and largest industry in the world. The construction industry has always been a contracting industry: there are numerous small enterprises. Currently construction is one of the largest industries in any economy. It plays an important role in the economy of the nation and is a source of employment for many. The construction industry refers to the process of designing, constructing, and maintaining buildings, infrastructure, and civil engineering works that influence the built environment and are essential for economic development, employment, and social progress; it can be divided into several distinct areas such as residential, commercial and industrial construction and civil construction, each with its unique construction methods and projects.

Human factors are often described as critical sources which contribute to the success of the project and increase the efficiency and performance in the construction industry. This is due to the poor technical management of the projects in being able to finish projects on time, within approved cost and to a satisfactory quality.

But the achievements of technical management of projects seem to have been limited. Therefore it may be necessary to consider behavioural project system management as a way of increasing success and productivity. Identifying and investigating sociological or human factors could thus be seen as a way of unlocking human potential to enhance productivity because these factors that may reinforce behaviour that in turn contributes to project success.

Workers' actions have a key role in ensuring the safety, productivity, quality and overall performance of construction projects. The construction sector is highly dynamic, with the jobs involving complex tasks and constant interaction between workers, supervisors, engineers, and project managers. Consequently, the actions, attitudes, judgment and communication behaviors of construction workers have a great impact on the success or failure of construction projects. Human actions, the compliance with safety rules, cooperation, risk awareness, and the individual reaction to work-related situations have a direct impact on operational efficiency and accident prevention, thus also on human behavior (Badke-Schaub & Schaub, 2022).

Human factors have a significant impact on workplace accidents and injuries, especially at construction sites. Studies show that unsafe workplace behaviours, including failure to wear personal protective equipment (PPE), risk-taking, lack of situational awareness, poor communication and lack of compliance with workplace safety procedures, are significant contributors to workplace incidents (Meng et al., 2021; Obolewicz et al., 2023). Such behaviors may be as a result of organizational culture, pressure at work, poor supervision, tiredness and environment, as well as technical shortcomings. This means it is vital to comprehend the human element in today's construction safety management.

To understand and predict workers' behaviour in construction settings, behavioural theories have become more and more adopted. According to TOW, attitudes, subjective norms and perceived behavioral control are the influences on a person's behaviour. This theory has been successfully applied to construction-related decision-making, demonstrating that workers' intentions and organizational influences significantly affect environmentally responsible and safety-related behaviors (Jain et al., 2020). Similarly, the relationship between personal values,

social norms, and behavioral outcomes has been recognized as an important factor influencing workplace performance and compliance with safety practices (Ponizovskiy et al., 2019).

Psychological and social factors also play a significant role in shaping construction workers' behavior. High job stress, excessive workloads, and psychological fatigue may reduce workers' attention and increase the likelihood of unsafe actions. Conversely, psychological resilience and supportive organizational environments have been shown to enhance psychosocial safety behavior and improve workers' ability to cope with occupational challenges (Lu et al., 2023). Furthermore, sociocognitive studies have demonstrated that unsafe behavior develops through complex interactions among individual cognition, environmental conditions, management practices, and peer influences, emphasizing the importance of behavioral interventions in improving construction safety (Ye et al., 2020).

Recent technological advancements have transformed the way human behavior is monitored and analyzed on construction sites. Artificial intelligence (AI), computer vision, deep learning, wearable technologies, and sensor-based monitoring systems are increasingly being employed to recognize workers' movements, detect unsafe behaviors, and provide real-time safety alerts. Deep learning models have demonstrated high accuracy in recognizing abnormal human behavior, enabling early identification of potentially hazardous situations before accidents occur (Jiang et al., 2023). Similarly, recent literature highlights that AI-based human behavior recognition systems are becoming an essential component of intelligent construction automation and safety management (Li & Zhu, 2024).

The integration of artificial intelligence into construction is not intended to replace human workers but rather to complement human decision-making and improve workplace safety. AI-assisted systems can continuously monitor construction activities, identify unsafe practices, and support supervisors in making timely interventions. However, successful implementation of these technologies depends on workers' acceptance, trust, training, and adaptation to new digital systems (Schia et al., 2019). Consequently, technological innovation must be accompanied by organizational efforts to improve safety culture and encourage positive behavioral change.

Virtual reality (VR) has also emerged as an effective tool for modifying construction workers' behavior by providing immersive safety training in simulated high-risk environments. Research has demonstrated that reinforcement learning with VR can substantially enhance

hazard recognition, fall risk perception, and fall prevention actions for construction workers, which is likely to decrease the risk of accidents on construction sites (Shi et al., 2019). Such behavioral training approaches enable workers to experience hazardous situations in a safe environment while developing appropriate responses to real-world risks.

From a broader perspective, human behavior can be viewed as an adaptive response to both physical and social environments. Behavioral ecology suggests that individuals continuously modify their behavior according to environmental conditions, available resources, and organizational structures (Ready & Price, 2021). In construction projects, this adaptive behavior influences teamwork, communication, productivity, and compliance with safety procedures. Therefore, effective project management requires not only technical expertise but also a comprehensive understanding of human behavior, organizational psychology, and behavioral risk management.

Overall, human behavior remains one of the most influential determinants of construction project success. Safe work practices, effective communication, psychological well-being, leadership support, and the adoption of intelligent technologies collectively contribute to improving construction safety and operational performance. As the construction industry continues to embrace digital transformation, integrating behavioral science with artificial intelligence and advanced monitoring technologies offers significant opportunities to reduce accidents, enhance worker well-being, and achieve sustainable project outcomes.

2. LITERATURE REVIEW

Michalik 2023 et al. purpose of the article is to provide a summary of the most popular techniques that can be used to study occupational accidents, as well as to demonstrate how they can be applied in practice, using a real-life case in a manufacturing company. The paper describes the theoretical basis of event and accident analysis and outlines some of the most common techniques, such as the 5 Whys approach, Ishikawa diagram, Technical-Organizational-Human (TOL) analysis, Failure Mode and Effects Analysis (FMEA), Event Tree Analysis (ETA), and Fault Tree Analysis (FTA). Using these approaches in the chosen accident case, the research finds out that the incident was caused by a complex of technical, organizational and human factors. The findings underline that the accidents at the workplace are often caused by a combination of factors, but not one of them. On the basis of the analysis, the article makes useful conclusions and suggests preventive actions to be taken to enhance

safety management systems and decrease the number of similar incidents in the future (Michalik, 2023).

Yang 2025 et al. Ineffective safety in the construction sector is known to be an issue of worldwide concern and unsafe practices by construction employees have been cited as the major cause of accidents. Based on social cognitive theory and analyzed using multiple regression methods, the experience of accidents will be categorized into direct and indirect categories to see how they contribute to unsafe behaviors of construction workers. The paper also examines the mediating variables of these relationships which are risk perception, safety attitude and safety competence. According to the data obtained on the basis of a structured questionnaire that was filled out by 334 valid respondents and analyzed with the help of structural equation modeling, it was found that the indirect experience has a greater negative impact on unsafe behaviors, which has the standardized path coefficient of -0.364 in comparison with direct experience, which has the standardized path coefficient of -0.154. Indirect experience is also a significant contributor in increasing the risk perception, safety attitude and safety competence with 66.8% of its total impact. The results are used to offer a guideline to mitigate unsafe practices (Yang et al., 2025).

Ghimire 2024 et al. Although the field of artificial intelligence is faster evolving in many sectors, the construction industry remains behind in terms of using these new technologies. Nowadays, modern large language models, including GPT, PaLM, and Llama, are of great interest to the world community because they demonstrate high efficiency in text generation that imitates human speakers and in the decision-making process, including complex cases. Nonetheless, the opportunities and challenges of integrating generative AI in the construction industry are still little researched, which represents a critical gap in the existing knowledge. This gap highlights the urgent need to explore how generative AI can be effectively implemented in construction practices, along with the potential complexities involved in its adoption. The potential uses of generative AI in the field of planning, design, communication, documentation, and project management are promising. Through reviewing literature, an industry perception analysis, and expert considerations, the study seeks to present a conceptual framework and practical recommendations in this area to be implemented and further research developed in the future (Ghimire et al., 2024).

Jiaqi 2024 et al. The behavior of the construction workers directly influences the level of labor productivity, personal safety, and the final quality of the project; hence, behavior control is a vital component of an efficient construction management. In this regard, the latest developments in computer vision have shown great capabilities of substituting the previous manual system of supervision on construction sites. In the paper, the current literature on the topic of computer vision-based behavioral monitoring of construction workers is reviewed based on bibliometric analysis and content analysis. The results are systematized into three key views: detection, localization and tracking of construction workers; recognition of construction related activities and monitoring of occupational health and safety behavior. The literature demonstrates that there has been a great increase in research activity in this area with a great deal of attention to safety related research with growing concerns to worker health and safety. Detection Object detection methods have also taken a leading position in the vision-based methods. It is likely that future studies will be aimed at combining several algorithms and enhancing the resilience of the systems. Limitations and future directions are also identified in the study and include the incorporation of generative AI models to have more effective monitoring possibilities (Li et al., 2024).

Primadi 2023 et al. The literature on employee performance, motivation, job satisfaction, employee engagement, and leadership is carried out to study the relations and impact of these variables on each other. A literature review methodology would be used whereby the sources of literature that are relevant to each construct chosen are collected and reviewed. An ordered summary of past research results is provided, outlining the contribution/impact that each of the factors has on employee performance. These findings reveal that there are several variables including motivation, job satisfaction, employee engagement, and leadership which play a critical role in employee performance, as seen through comparative analysis in a matrix format. These interrelated factors are strong supports of employee performance and they contribute towards high productivity and organizational effectiveness. In sum, the review shows that motivation enhancement, leadership reinforcement, job satisfaction improvement, and employee engagement nurturing are key actions that should be taken to attain greater employee performance levels within the organizational context (Primadi Candra Susanto et al., 2023).

- **Statement of the Problem**

The construction industry continues to experience a high rate of workplace accidents despite improvements in safety regulations and technological advancements. Existing research primarily focuses on technical failures and environmental hazards, while the influence of human behaviour remains insufficiently explored. Behavioral factors such as stress, fatigue, risk perception, and unsafe practices are often studied independently rather than as interconnected contributors to accidents. Furthermore, there is a lack of predictive models capable of identifying unsafe behaviors before incidents occur and limited integration of advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and real-time monitoring systems. Additionally, contextual, cultural, and long-term behavioral studies remain inadequate, restricting the development of effective accident prevention strategies.

- **Research Objective**

a) To examine how human behavior influences occurrence and severity of accidents at construction sites overall.

b) To identify common unsafe practices and behavioral patterns among workers contributing to construction site accidents.

c) To analyze relationship between workers safety awareness attitudes and compliance with established construction safety protocols.

d) To assess impact of fatigue stress workload and environmental conditions on behavior and accident occurrence.

e) To recommend strategies and training programs for improving safety behavior and reducing accidents construction sites.

3. RESEARCH METHODOLOGY

The research methodology for this study is carried out through a systematic sequence of steps to ensure the collection of accurate, reliable, and meaningful data regarding the role of human behavioral factors in construction site accidents. The methodology follows the steps presented below:

- **Research Design**

The study adopts a descriptive and analytical research design. The descriptive design helps in understanding the existing safety practices, worker behaviour, and accident-related conditions at construction sites, while the analytical design examines the relationships between human behavioral factors and accident occurrence.

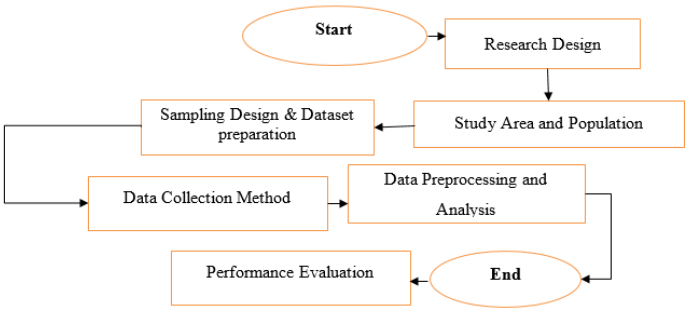

Figure 1: Proposed Flow Chart

- **Research Approach**

A quantitative research approach, supported by limited qualitative inputs, is employed. Quantitative data provide measurable information for statistical analysis, whereas qualitative insights obtained through interviews and observations help explain workers' perceptions and experiences regarding safety practices.

- **Study Area and Population**

The research is conducted at selected construction sites representing different types of construction projects. The target population includes construction workers, site supervisors, safety officers, and project managers who are directly involved in construction activities and safety management.

- **Sampling Technique and Sample Size**

A stratified random sampling technique is used to ensure proper representation of each respondent category. The population is divided into different strata according to job roles, and respondents are selected randomly from each group to minimize sampling bias and improve the reliability of the findings.

- **Data Collection Methods**

Both primary and secondary data are utilized. Primary data are collected through structured questionnaires, interviews, and direct observations, while secondary data are obtained from accident records, safety reports, books, journals, research articles, and other relevant documents.

- **Research Instrument Design**

A structured questionnaire is developed to measure demographic characteristics, safety awareness, behavioral practices, accident causes, training effectiveness, and supervision. The questionnaire mainly consists of Likert-scale, multiple-choice, and close-ended questions.

- **Data Collection Procedure**

Permission is obtained from construction site authorities before conducting the survey. Respondents are informed about the purpose of the study, confidentiality is assured, questionnaires are administered, interviews are conducted with selected participants, and on-site observations are carried out to collect comprehensive data.

- **Data Processing and Analysis**

The collected data are coded, organized, and analyzed using SPSS and Microsoft Excel. Statistical tools such as percentage analysis, mean, standard deviation, correlation analysis, and regression analysis are applied to identify behavioral factors influencing construction site accidents.

- **Reliability and Validity**

The research instrument is evaluated through expert review and pilot testing. Reliability is ensured through consistent measurement procedures, while validity confirms that the questionnaire accurately measures the intended research variables.

- **Ethical Considerations**

Ethical principles are strictly followed throughout the research. Participation is voluntary, informed consent is obtained, respondents' identities remain confidential, and all collected information is used solely for academic purposes.

4. RESULTS AND DISCUSSION

- **Influence of human behavior on accident occurrence and severity**

Table 1: Behavior Type and Accident Frequency

Behavior Type	Mean Score	Accident Frequency (%)
Safe Behavior	4.3	10
Moderate Behavior	3.6	25
Risky Behavior	3.0	40
Highly Unsafe Behavior	2.5	55

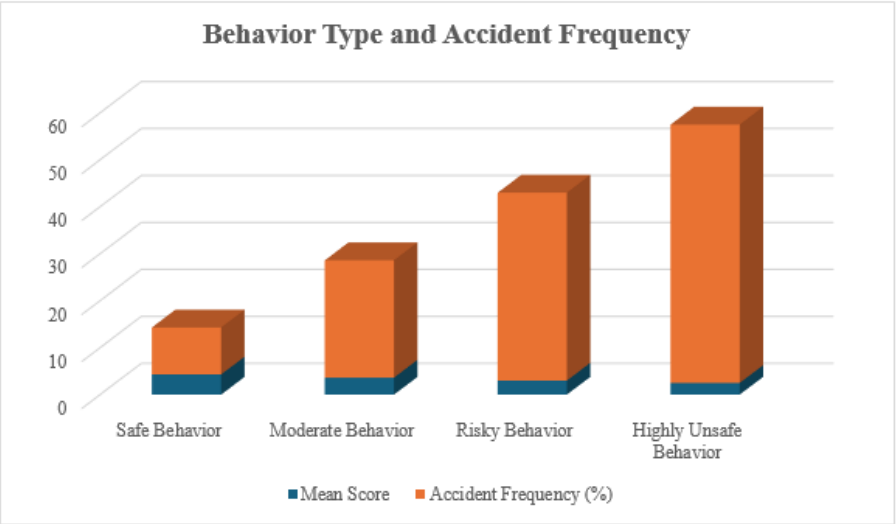

Figure 2: Behavior vs Performance

According to the table, there is an apparent negative relationship between the compliance level and the accident rate. High compliance (score 4.5) workers (lowest accident rate 12%), and very low compliance (2.2) workers (highest rate 60%). The reduction in compliance leads to an upsurge in accidents, which underscores the need to follow safety measures to the letter.

Table 2: Behavior under Pressure Conditions

Condition	Safe Behavior (%)	Unsafe Behavior (%)
Normal Work	75	25
Time Pressure	55	45
Emergency	40	60
Overtime Work	35	65

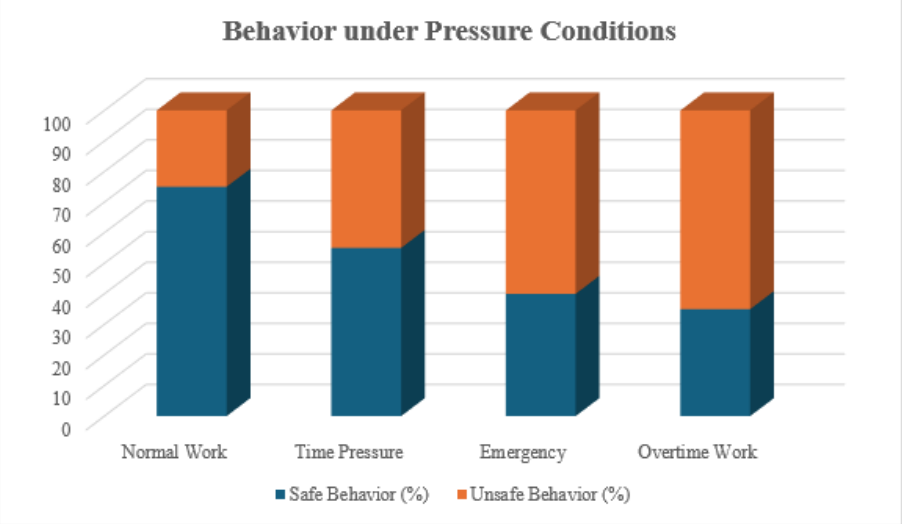

Figure 3: Behavior and Severity of Injuries

The table shows that safe behavior decreases under challenging conditions. Safe behavior is maximum during normal work (75%), and the level decreases during time pressure (55%), and emergencies (40%). The lowest safe behavior (35%) and the highest unsafe actions (65%) are observed in overtime work, which means that stress, urgency, and fatigue make his work more dangerous.

- **Identification of unsafe practices and behavioral patterns**

Table 3: Common Unsafe Practices

Practice	Percentage (%)	Rank
Not using PPE	70	1
Ignoring instructions	65	2
Improper tool handling	58	3
Unsafe speed	50	4

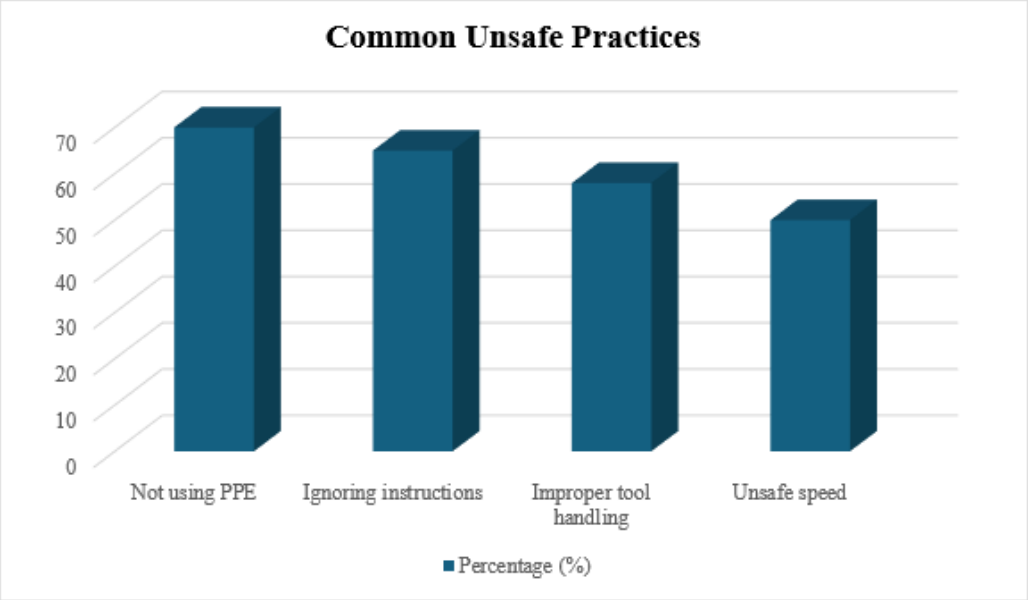

Figure 4: Common Unsafe Practices

- **Safety awareness, attitude, and compliance**

Table 4: Training Impact on Compliance

Training Type	Compliance Score	Improvement (%)
Regular Training	4.6	40

Occasional Training	3.8	25
Rare Training	3.0	15
No Training	2.5	5

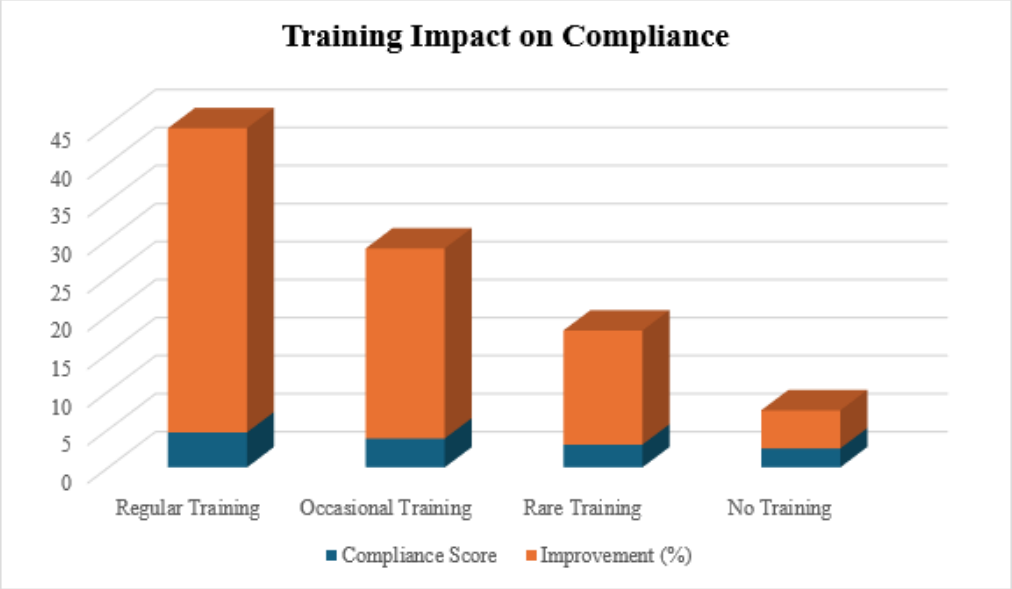

Figure 5: Awareness vs Accident Rate

The table shows how frequency of training affects safety compliance and level of improvement among construction workers. The highest compliance score (4.6) and the most significant improvement (40%), which demonstrates high efficiency in encouraging safe behavior, is observed with regular training. Moderate compliance (3.8) is observed after occasional training with 25% improvement and limited impact of rare training (3.0 score and 15% improvement). The lowest compliance score (2.5) and lowest improvement (5%), which is poor performance in terms of safety, are recorded through workers who are not trained. In general, the results prove that regular safety training can considerably increase compliance and decrease the risk of accidents.

- **Impact of fatigue, stress, workload, and environment**

Table 5: Environmental Factors Impact

Factor	Impact (%)
Heat	55
Noise	40
Poor Lighting	50
Dust	45

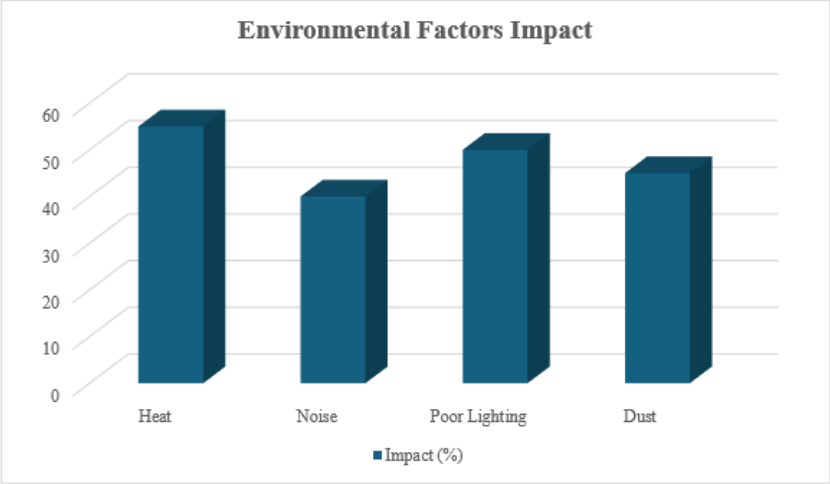

Figure 6: Environmental Factors Impact

The table draws a focus on the effect of the environmental factors on the construction site safety. The heat factor is the most influential (55%), which means that extreme temperatures influence the comfort of the workers, their fatigue, and their performance considerably. Poor lighting (50%) is also a compelling contributor to safety hazards as it has an impact of decreased visibility and chances of making mistakes. Dust (45%) impacts the health and concentration of workers and noise (40) results in communication challenges and loss of awareness. On the whole, the statistics indicate that severe environmental conditions contribute significantly to the risk of accidents, and appropriate management of the site and protection should be considered.

- **Correlation analysis of human factors**

Table 6: Combined Human Factors Index

Factor Group	Score
Behavioral	4.2
Psychological	3.5
Physical	3.2
Environmental	3.0

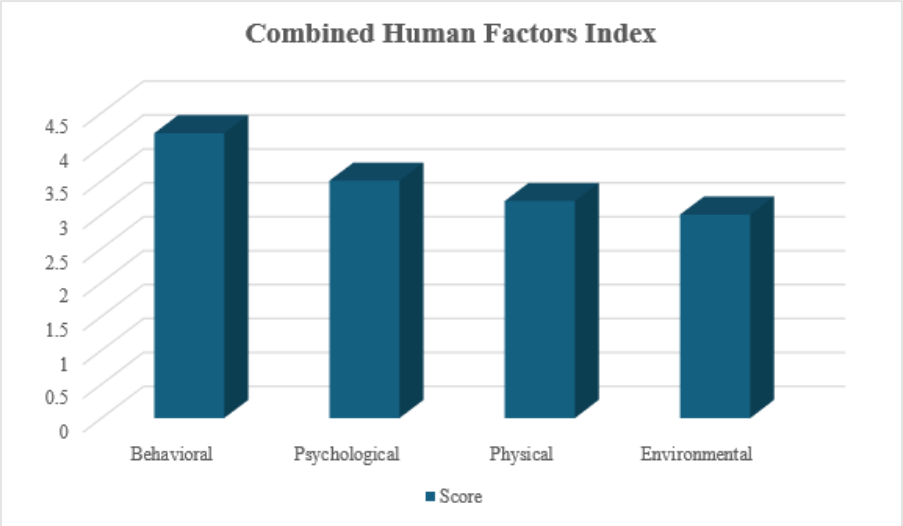

Figure 7: Combined Human Factors Index

The table shows the scores of various factor groups, which impact on construction site safety. The highest score (4.2) is behavioral factors, which means that worker behavior is the most important in safety performance and accident prevention. Psychological factors (3.5) are also significant in their effect as an indicator of the effect of stress, attention, and decision-making on safety outcomes. Physical factors (3.2) bring to light the role of fatigue and workload in influencing worker performance. Environmental factors are the least scored (3.0) but they are still associated with safety risks due to heat, noise and poor visibility. In general, behavioral factors are the most important safety determinants.

- **Regression analysis of accident predictors**

Table 7: Predictor Importance Ranking

Factor	Importance (%)
Unsafe Behavior	35
Awareness	30
Fatigue	20
Stress	15

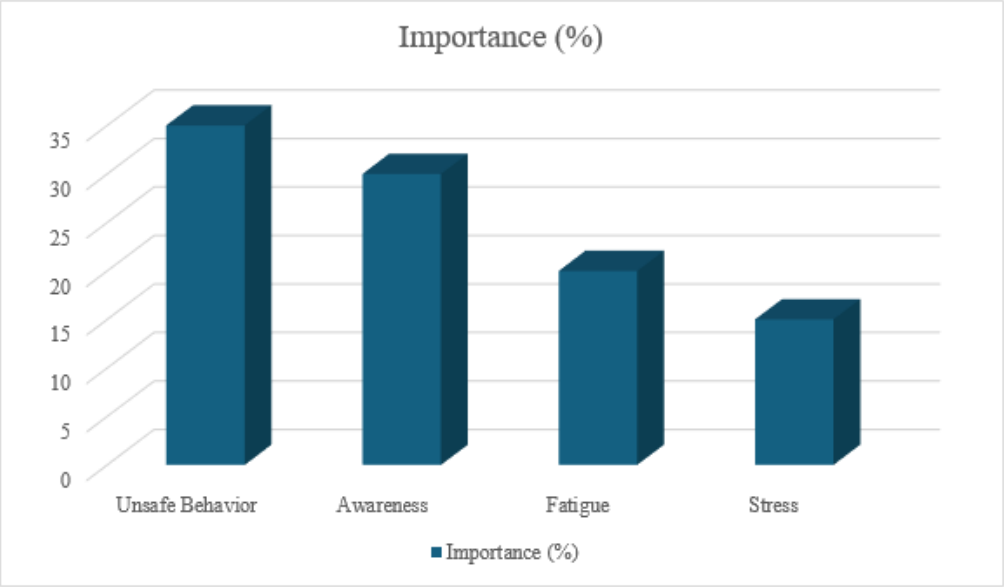

Figure 8: Predictor Importance Ranking

The table presents the list of the important factors which can affect the accidents on construction sites by their significance. The most significant factor (35%), is unsafe behavior, which implies that unsafe actions and failure to adhere to the safety rules are the root causes of accidents. Second (30 per cent) is safety awareness, where knowledge and understanding of safety procedures are important. Fatigue (20%) is another important factor, whereby physical and mental fatigue predisposes the occurrence of errors. The last and least (15%), but not insignificant is stress, which influences worker performance. On balance, the findings underscore the fact that behavioral factors are the most effective in the prevention of accidents.

5. CONCLUSION

Study results confirm that human behavior is one of the most critical factors to be taken into consideration that can have an impact on safety performance in the construction industry. The results showed that unsafe behaviours, such as not following safety procedures, not wearing PPE, procedural errors, and communication were all linked to the occurrence and severity of construction accidents. The factors that were most correlated with accident risks were found to be behavioral factors, followed by safety awareness, fatigue, and occupational stress. The study also shows that, when the working conditions are overtime, emergency, and high time pressure, the workers are more likely to take unsafe work practices, which leads to higher risk of accidents. On the other hand, frequent safety training, good supervision, and attitude towards safety can greatly enhance workers' adherence to safety rules and mitigate unsafe behavior. In summary, fostering positive human behavior and enhancing behavioral safety management practices are crucial for minimizing work site accidents, enhancing worker health, and ensuring safer and more productive construction projects.

- **Future Scope**

a) Advanced Behavioral Studies

Future research can explore advanced psychological and cognitive models to better understand workers' decision-making, risk perception, stress, fatigue, and unsafe behaviors. Studying behavioral patterns such as overconfidence and peer influence can help develop targeted interventions that improve safety awareness, reduce risky actions, and minimize construction site accidents.

b) Use of Technology in Safety Management

Future studies can investigate the use of Artificial Intelligence (AI), wearable sensors, machine learning, and computer vision for real-time safety monitoring. These technologies can identify unsafe behaviors, predict potential hazards, and provide early warnings, enabling proactive safety management and reducing accident risks at construction sites.

c) Development of Behavior-Based Safety Programs

Future research should evaluate the effectiveness of Behavior-Based Safety (BBS) programs in improving workers' safety behavior and reducing accidents. Studies can examine

observation-based feedback, reward systems, and employee participation to identify practical strategies that strengthen safety culture and encourage long-term compliance with safety regulations.

d) Integration of Digital Tools

Future research can explore the integration of Building Information Modeling (BIM), Virtual Reality (VR), and other digital technologies into construction safety management. These tools can improve hazard identification, enhance safety training through realistic simulations, and increase workers' awareness, knowledge retention, and overall safety performance.

e) Focus on Mental Health and Well-being

Future studies should investigate the relationship between mental health, stress, fatigue, burnout, and construction site safety. Research can evaluate workplace wellness initiatives, counselling services, work-life balance, and stress management programs to improve workers' well-being, decision-making, productivity, and overall safety performance.

References

1. Badke-Schaub, P., & Schaub, H. (2022). Human behavior, roles, and processes. In *Handbook of Engineering Systems Design* (pp. 1-36). Cham: Springer International Publishing.

2. Jain, S., Singhal, S., Jain, N. K., & Bhaskar, K. (2020). Construction and demolition waste recycling: Investigating the role of theory of planned behavior, institutional pressures and environmental consciousness. *Journal of Cleaner Production*, *263*, 121405.

3. Jiang, L., Zou, B., Liu, S., Yang, W., Wang, M., & Huang, E. (2023). Recognition of abnormal human behavior in dual-channel convolutional 3D construction site based on deep learning. *Neural Computing and Applications*, *35*(12), 8733-8745.

4. Li, S., & Zhu, A. (2024, July). Recent advancements with human behavior recognition and ai in construction automation: A literature review. In *2024 International Conference on Advanced Robotics and Mechatronics (ICARM)* (pp. 759-764). IEEE.

5. Lu, C., Yu, D., Luo, Q., & Xu, C. (2023). A study of the effects of job stress on the psychosocial safety behavior of construction workers: the mediating role of psychological resilience. *Buildings*, *13*(8), 1930.

6. Meng, Q., Liu, W., Li, Z., & Hu, X. (2021). Influencing factors, mechanism and prevention of construction workers' unsafe behaviors: A systematic literature review. *International journal of environmental research and public health*, *18*(5), 2644.

7. Obolewicz, J., Baryłka, A., & Szota, M. (2023). The impact of human behaviour on the (un) safety of the construction site. *Journal of Achievements in Materials and Manufacturing Engineering*, *119*(1).

8. Ponizovskiy, V., Grigoryan, L., Kühnen, U., & Boehnke, K. (2019). Social construction of the value–behavior relation. *Frontiers in psychology*, *10*, 934.

9. Ready, E., & Price, M. H. (2021). Human behavioral ecology and niche construction. *Evolutionary Anthropology: Issues, News, and Reviews*, *30*(1), 71-83.

10. Schia, M. H., Lædre, O., & Fyhn, H. (2019). The introduction of AI in the construction industry and its impact on human behavior. In *Proc. 27th Annual Conference of the International Group for Lean Construction (IGLC)*.

11. Shi, Y., Du, J., Ahn, C. R., & Ragan, E. (2019). Impact assessment of reinforced learning methods on construction workers' fall risk behavior using virtual reality. *Automation in Construction*, *104*, 197-214.

12. Ye, G., Yue, H., Yang, J., Li, H., Xiang, Q., Fu, Y., & Cui, C. (2020). Understanding the sociocognitive process of construction workers' unsafe behaviors: An agent-based modeling approach. *International journal of environmental research and public health*, *17*(5), 1588.

13. Ghimire, P., Kim, K., & Acharya, M. (2024). Opportunities and Challenges of Generative AI in Construction Industry: Focusing on Adoption of Text-Based Models. Buildings, 14(1). https://doi.org/10.3390/buildings14010220

14. Li, J., Miao, Q., Zou, Z., Gao, H., Zhang, L., Li, Z., & Wang, N. (2024). A Review of Computer Vision-Based Monitoring Approaches for Construction Workers' Work-

Related Behaviors. IEEE Access, 12(December 2023), 7134–7155. https://doi.org/10.1109/ACCESS.2024.3350773

15. Michalik, J. (2023). overview of methods for investigating accidents at work based on an accident in a manufacturing company. 8(1), 146–156. https://doi.org/10.2478/czoto-2023-0014

16. Primadi Candra Susanto, Siera Syailendra, & Ryan Firdiansyah Suryawan. (2023). Determination of Motivation and Performance: Analysis of Job Satisfaction, Employee Engagement and Leadership. International Journal of Business and Applied Economics, 2(2), 59–68. https://doi.org/10.55927/ijbae.v2i2.2135

17. Yang, S., Liu, L., Wang, T., Guo, Y., Qian, Y., & Chen, H. (2025). The Impact of Accident Experience on Unsafe Behaviors of Construction Workers Within Social Cognitive Theory. Buildings, 15(1), 1–19. https://doi.org/10.3390/buildings15010059