BOOK OF ABSTRACTS

2024 (3rd) CONSTRUCTION SAFETY CONFERENCE

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Lawrence, Kansas, USA

KU THE UNIVERSITY OF KANSAS School of Engineering

NCCS The Craig and Diane Martin NATIONAL CENTER FOR CONSTRUCTION SAFETY

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Book of Abstracts

2024 (3rd) Construction Safety Conference

Edited by

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Conference Chair's Message

Dear participants:

In 2022, the construction industry reported 1,092 fatalities, marking a 7.6% increase from the 1,015 deaths in 2021 and continuing a streak of more than 1,000 fatalities annually for seven consecutive years. The fatality rate for 2022 was 9.3 per 100,000 full-time equivalent workers (FTEs), up from 9.1 in 2021 but lower than the peak of 9.8 per 100,000 FTEs seen in 2012. These figures highlight ongoing challenges in workplace safety within the sector despite fluctuations in fatality rates over recent years.

The Construction Safety Conference is one of the first conferences to bring practitioners and researchers together to exchange ideas on mitigating burdens in construction safety. This year, we have keynote speakers from the construction industry and academia. In that, Mike Schneider addresses the best practices in Baker Concrete, whereas Georgi Popov introduces his research findings in Prevention through Design (PtD).

Two parallel sessions are offered in CSC 2024. The practical application session focuses on pragmatic construction safety subjects, such as safety helmets, safety metrics, and workplace emergency tools. The other session, knowledge generation, promises to present state-of-the-art construction safety research findings. We hope attendees can understand the practical construction safety issues and solve them using new construction safety knowledge.

We here at the National Center for Construction Safety wish you a safe and enjoyable conference in Lawrence, Kansas.

Best regards,

Chien-Ho Ko, PhD, PE
Conference Chair, CSC 2024
Craig and Diane Martin National Center for Construction Safety
University of Kansas

Scientific Chair's Message

Dear participants,

Seasons' Greetings!

I am delighted to extend my warmest greetings to all of you attending the 2024 Construction Safety Conference at the University of Kansas, USA. It is my honour to welcome esteemed academicians, professionals, undergraduate, postgraduate, and doctoral candidates, as well as industry experts to this significant event.

Variety of thrust areas of the conference have focused on the various horizons of the innovations in the field of construction safety. Across the globe, 24 papers have received and undergone the double-blind peer review process to meet the highest quality standards. Out of these, 12 manuscripts have been selected and their authors have been invited for the presentations in the CSC 2024. Nine presenters could plan and register for the CSC 2024. The sessions of the conference are divided based on the thrust areas of the conference.

I would like to express my heartfelt gratitude to the organizing committee for their tireless efforts in making this conference a reality. Their dedication and commitment have ensured that we have a platform to exchange knowledge, learn from one another, and inspire progress.

Wishing you a fruitful and memorable conference.

Sincerely,

Dilip A. Patel, PhD, LLB,
Scientific Chair, CSC 2024
Professor in Department of Civil Engineering
Sardar Vallabhbhai National Institute of Technology, Surat, India

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Managing Risks in Tertiary Education Building Projects: Insights from Construction Stakeholders

Deborah Oluwafunke Adedokun[1], Isaac Olaniyi Aje[2], and Bernard Tuffour Atuahene[3]

Abstract: The demand for quality education and achieving high literacy rates in developing countries require a resilient and safe infrastructure in tertiary institutions. However, the achievement of such a level of infrastructure comes with embedded risks, which have escalated costs and timelines issues as compared to construction activities in other sectors of the economy. This study examines the peculiar risks associated with achieving resilient and safe tertiary education building projects. The data was collected from 295 construction stakeholders involved in tertiary education building projects through a quantitative questionnaire. The data was analysed through mean score ranking, standard deviation, and exploratory factor analysis. Eight (8) components emerged, which include design, political, construction, legal, logistics, environmental, financial, and management risk factors. The identified risks resonate beyond the realm of project management, extending to the domain of construction safety, especially the identified environmental risk factor. By discerning and proactively addressing influential risk factors, stakeholders hold the key to cultivating a safer working environment, thus mitigating the prevalence of accidents and injuries on construction sites. Moreover, embracing robust risk management strategies and crafting contingency funds emerge as imperative steps towards fortifying project performance and fostering a culture of safety within the construction landscape.

Keywords: Construction projects, Education building, Nigeria, Risk factors, Tertiary education building projects.

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A Multi-Output Regression Approach to Predicting Gender-Centric Workplace Fatal Accidents

Deepanshu Mahajan[1], Emel Sadikoglu[1], Uttam Kumar Pal[2], Saksham Timalsina[2], Chengyi Zhang[2], and Sevilay Demirkesen[1]

Abstract: The prevalence of accidents that pose substantial concerns, given their potential to cause severe injuries, loss of lives, and long-term health implications for workers across various industries highlights the need for effective accident prevention measures. It is imperative to analyze accident characteristics and different features leading to accidents. Hence, this study investigates the involvement of male and female workers in different industry accidents and explores their contributing factors. The number of men and women involved in accidents is examined through the application of linear regression, and tree-based methods, which are Random Forest, Extra Trees, and XGBoost Regressors, within the context of constrained multi-output regression, based on the data from the year 1992 to 2015. A model to predict gender-wise accidents for the years 2016 to 2021 has been developed using historical data, and its accuracy is compared with the actual data of the same period. The Mean Average Percentage Error (MAPE) method is employed to assess the accuracy of the prediction where the results show an error of 2.61%, 9.73%, and 2.86% in the number of accidents for male, female, and total workers, respectively. Moreover, the feature importance analysis is conducted to identify the key factors influencing the number of accidents for both genders. The analysis reveals that the number of wage and salary workers has the highest importance for both genders, followed by the number of working-age and younger-age workers for the accident prediction of men and women workers, respectively. This study aims to gain valuable insights into the underlying factors that contribute to accident occurrence and enhance the understanding of accident involvement among men and women. The study results can contribute to the development of effective strategies to prevent accidents, protect workers, and promote a safer working environment by predicting accidents using machine learning models.

Keywords: Workplace accident, Accident prediction, Occupational safety, Gender-based accident, MAPE approach, Feature importance.

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Demographic Factors Mediating Organizational Commitment and Safety Performance at Ovid Construction

Eshetie Berhan[1], Sisay Geremew Gebeyehu[2], and Fekadu Geremew Gebeyehu[3]

Abstract: This study aimed to investigate the mediating role of demographic characteristics between organizational commitment and occupational health and safety performance at, Ovid Construction PLC, a leading private company in Ethiopia. A cross-sectional study design was employed, and a sample of 370 workers was selected using systematic random sampling. A structured questionnaire was used to collect data, and both descriptive and multivariate analysis techniques were employed. The results showed that organizational commitment positively and significantly affects occupational health and safety performance, and demographic characteristics except age positively and significantly affect occupational health and safety performance. Moreover, except aga, demographic profiles (Education Level and Work Experience) significantly and partially mediate the relationship between the two Organizational Commitment variables (Safety Measures and Work Environment) and Occupational Accident. The study highlights the importance of considering demographic factors in organizational commitment and safety training programs to improve occupational health and safety outcomes.

Keywords: OHS; Construction; Ovid; Demographic; Management Commitment

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Evaluation of Factors that Impede the Use of Construction 4.0 Technologies for Construction Safety Management

Vimlesh Prabhu Desai[1], Lysette D'souza[2], Anil Singh[3], and Vikram Bhadauria[4]

Abstract: The safety performance of the construction sector remains subpar, despite the utilization of both conventional and new methodologies. Consequently, there is a decline in the standard of work, efficiency of employees, and an escalation in project expenses and duration. In recent years, there has been a surge in interest among practitioners and researchers regarding digitalization, automation, and the use of digital technologies, in construction industry. However, the utilization of these smart, intelligent and interconnected Construction 4.0 technologies is not yet widespread and, by far, may be a factor for the poor safety record in the construction industry. This study aims to identify and evaluate factors that impede the use of these technologies to improve health and safety in Indian construction industry. Literature review and interviews, with six experts having a minimum of ten years of experience in construction safety management, were used to identify 18 factors. Thereafter, a questionnaire survey was administered among industry professionals with a minimum of four years of construction safety management experience to evaluate these factors on a 5-point Likert scale. Responses from 217 professionals were analyzed using the relative importance index (RII) and factor analysis. The analyses showed 'employees' resistance and reluctance to change', 'high upfront investment', 'lack of awareness about digital technologies and their benefits', 'limited trained workforce to work on digital technologies', and 'poor data communication infrastructure facilities' as the top five barriers. Factor analyses churned out six groupings: 'Organization readiness', 'Industry readiness', 'Country readiness', 'Technology related', 'Data related', and 'Investment related', on the basis of latent characteristics of the factors. The findings will aid firms, government, and academia to direct resources and plan strategies to improve the usage of Construction 4.0 technologies in safety and health management in the construction industry.

Keywords: Construction 4.0, Construction, Digital technologies, Factor analysis, RII

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Organizational Elements that Shape Construction Employees' Approach and Behavior Towards OSH

Vimlesh Prabhu Desai[1], Lysette D'souza[2], Anil Singh[3], and Vikram Bhadauria[4]

Abstract: The construction industry has one of the highest known rates of occupational incidents. Construction organizations are increasingly recognizing the significance of occupational safety and health (OSH) problems as a prominent area of concern. Though numerous studies have shown that employees' behavior and approach towards OSH are impacted by Environmental (such as governmental regulations), Personal and Organizational factors, there is a lack of consensus on the organizational elements. Hence, the primary objective of this study is to ascertain the organizational elements that influence employees' adherence to OSH and suggest improvement needs, if any. To achieve the objective, the study adopted a qualitative research approach and conducted semi-structured interviews with fifteen highly experienced professionals in the construction industry. Using manual thematic analysis, the interview transcripts were analyzed to identify and extract major themes based on commonalities. Six themes were recognized: empowerment, communication, knowledge management and learning & development, leadership & top management commitment, internal systems & processes, and work culture & spirituality. The findings of this study will assist the industry in developing a framework of effective solutions for OSH management. These themes can form the basis of a good approach to an integrated OSH strategy.

Keywords: OSH, Approach, Behaviour, Elements, Employee, Thematic analysis.

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Tackling Challenges in Implementing Behavior-Based Safety (BBS): Construction Safety Culture Focus

Ahmed Jalil Al-Bayati[1], Tiago Troyano Pereverziev de Abreu[1], and Chien-Ho Ko[2]

Abstract: The dynamic nature of the construction industry renders it inherently hazardous, leading to elevated rates of occupational injuries. Thus, it is imperative to explore diverse strategies aimed at mitigating these risks. One such approach is Behavior Based Safety (BBS), which targets the enhancement of safety performance by addressing the behaviors of construction workers. This study undertook a systematic literature review on BBS in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Through this research endeavor, the aim is to deepen the industry comprehension of the conceptual framework, operational mechanisms, and inherent limitations of BBS within the construction industry context. Exploring the intricacies of BBS offers valuable insights into its operational mechanisms and underlying principles within the construction context. The comprehensive review encompassed 14 scholarly articles published between 2010 and 2023, all cataloged within the American Society of Civil Engineers (ASCE) or ScienceDirect databases. Findings from these studies shed light on the effectiveness of BBS and its inherent limitations when applied within construction environments. It becomes increasingly evident that prioritizing safety culture might supersede the sole reliance on BBS methodologies within the construction sector.

Keywords: Behavior Based Safety, BBS, Safety Behavior, Construction Safety Culture

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Utilizing BIM to Enhance Construction Safety for High-Rise Buildings: A Proactive Risk Assessment Approach

Dhyey Gondalia[1] and Lukman E. Mansuri[1]

Abstract: Safety is the most important aspect of any construction project, right from the beginning stage of the project to the end of the project. But in some cases due to a lack of awareness and casual attitude towards safety, proper precautions regarding it are not taken and hence it leads to severe accidents. Hence it affects every part of the project. So to reduce this kind of fatal accident this project is undertaken. In this project, the work is done regarding the automatic generation of safety schedules with the help of BIM. This whole process is carried out with the help of a questionnaire survey for risk assessment and by the use of different software like Revit 3D, and Unity. The application is related to it, which shows how severe the hazards are in doing this activity. So the person who is going to do this activity will know which safety precautions to take for doing it. Hence it leads to the safe completion of the activity. The main advantage of developing this kind of application is the person can know that what kind of safety precautions he/ she should take so that any accident and damage to health does not occur. Thus, it helps in the safe and on-time completion of the project.

Keywords: BIM, Safety, Risk, Safety schedules, Risk matrix.

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Evaluating Stakeholder Awareness and Prioritizing Applications of UAVs Technology for Construction Safety Management

Harshil Halvadia[1], K. A. Patel[1], and D. A. Patel[1]

Abstract: Recent technological advancements have presented opportunities for enhancing construction safety. Among these, unmanned aerial vehicles (UAVs) hold promising potential to revamp safety monitoring, inspection, and implementation. However, their adoption in the Indian construction industry remains in its nascent stages. Therefore, this study seeks to evaluate stakeholder awareness regarding UAVs application for Construction Safety Management. The investigation unfolds in two phases: (i) Evaluating awareness and (ii) Prioritizing applications. For these purposes, the study surveyed and interviewed 108 project management consultants (PMCs), contractors, clients and experts to evaluate their familiarity with UAVs technology. Findings reveal that 74.07% of stakeholders possess some awareness of UAVs. Building upon existing literature, eight key applications for UAVs in construction safety were identified. Utilizing the Relative Importance Index (RII) method, these applications are prioritized based on stakeholder input and a high level of correlation is observed among stakeholder's viewpoints. Notably, safety audits emerged as the highest-ranked application. This valuable insight serves as an evidence base for promoting UAVs adoption and fostering improved safety management practices in the Indian construction sector.

Keywords: Unmanned Aerial Vehicles (UAVs), Construction Safety, Relative importance index (RII), India.

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Lean Practice Techniques for Safer Off-Site Construction in Malawi

Wakisa Simukonda[1] and Fidelis Emuze[2]

Abstract: In off-site construction (OSC), lean practice is one of the philosophies used to improve safety performance. While lean practice is recognized as an essential mechanism for addressing poor safety performance, limited empirical insight is available on lean practice techniques (LPTs) implemented by OSC contractors in developing countries. This study investigated the LPTs implemented by OSC contractors for safety improvement in Malawi. The qualitative data were collected using semi-structured interviews with 13 OSC contractors in Malawi. Thematic analysis was used for data analysis, with the 'summative' approach used partially for quantitative counting and comparison of the keywords or phrases. Overall, 30 LPTs were identified as being implemented by OSC contractors in Malawi. Out of the 30 LPTs, only 6 LPTs reached the 46% cut-off point of significantly implemented LPTs. Such LPTs included 'use of personal protective equipment (PPE);' 'provision of necessary working equipment' and 'shining' (n = 13, 100%); 'use of visual tools' (n = 10, 76.92%); 'use of safeguards' (n = 7, 53.85%); and 'use of visual safety demarcations and borders' (n = 6, 46.15%). The study's implication lies in identifying LPTs that improve construction safety on OSC projects in Malawi. These can be implemented in similar developing countries. Improvement efforts would need to focus on LPTs with low implementation and initiatives that focus on helping contractors improve their lean practice. The study findings also allow project actors to develop interventions supporting LPT implementation to enhance construction safety performance.

Keywords: Contractors, lean practice techniques, off-site construction, safety.

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Human-AI Partnership to Improve Construction Workers' Experience on Safety, Performance, and Health: A Systematic Review of The North American Construction Industry

Md Nazmus Sakib[1] and Amir H. Behzadan[2]

Abstract: Although construction is one of the oldest, most dynamic, and unsafe sectors of the global economy, the digital innovation and application of artificial intelligence (AI) in the industry still need to be improved. For the past several years, however, with rapid advancements in supporting technologies and computing power, the construction industry has made several strides in digitalization, data-driven design and planning, and automation. As the industry is in the process of adopting and customizing AI-powered tools and technologies in its daily workflows to improve safety, new opportunities are being created to enable human workers and stakeholders to seamlessly collaborate with AI in various aspects of project design, planning, construction, operation, and maintenance. The promise of human-AI collaboration in construction has, in turn, given rise to new research endeavors that focus on adaptability, usability, and expandability rather than mere algorithmic development. Prior to implementing any new AI technology in construction, users need to understand the impact of this adoption on human workers' safety, performance, and health. Despite several systematic literature reviews on the applications of AI in construction, to date, there is limited investigation into the workers' experience during such transition from traditional to AI-driven work. In this study, a systematic literature review on AI in the construction industry is conducted through the lens of how such implementation might affect human workers' safety, performance, productivity, and health experience. The paper identifies common human factors involved in introducing AI and discusses the connection between those factors and potential AI applications in the industry. Finally, future directions for human-AI partnership in construction are outlined.

Keywords: Human-AI, Human factors, Workers' experience, Construction.

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