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Automation of the Operation of Machines in Construction Industries

Zoya Fernandes [a], Sanjay Malhotra [b]

[a] *Nordic Center for Fictional Theory, Aarhus Literary College, Denmark.*
[b] *Nordic Center for Fictional Theory, Aarhus Literary College, Denmark.*

Abstract

The main goal of this task is to gather accurate and complete information about accidents. We collect data from owners, contractors, and construction firms to build a comprehensive accident graphics database. This database organizes the sources and causes of accidents, fatalities, and general information into various modules. The categories we choose focus on local occurrences of errors rather than the broader context of accident causes. Providing extra training for safety managers can make a real difference. Additionally, holding at least three meetings to discuss safety performance with field supervisors and project managers is crucial in the construction industry. Having clear guidelines can help companies create effective safety programs. An effective safety program not only boosts productivity but also reduces project costs and enhances the company's reputation with project owners.

Keywords: Mechanization, Quantitative, Manufacturing, Construction Industry, Automation.

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Introduction

The controlled settings and working conditions prevalent in manufacturing and other businesses are in sharp contrast to this. Safety is an essential component that helps avoid needless property loss, injuries, and even lives; it shouldn't be viewed as a luxury. Preventing workplace diseases and injuries must be a top priority for all businesses. There must be a determined effort to educate employers and workers on the importance of health and safety at work, especially in developing nations (Everett & Slocum, 1994). Training and the implementation of thorough safety measures should be the main priorities for both developed and developing countries. Accidents in the construction industry can be incredibly costly, impacting healthcare, legal fees, management time, and workers' compensation, among other things. Additional costs can arise from transportation, lost productivity, repairing or replacing damaged equipment, and hiring new workers. In this context, it seems that organizations bear the costs of safety either through the expenses related to accidents or by investing in safety programs. Thus, accident prevention should be a top priority for any contractor. The safety of project personnel and construction workers can't be ensured by legislation alone, nor should it rest solely on the shoulders of the employer or contractor. Employees need to be engaged, and job safety should be a collective effort, achievable through training and education (Balaguer & Abderrahim, 2008). The benefits of a solid safety program for organizations include increased profits, enhanced reputation, and lower insurance premiums. Most importantly, it leads to a significant reduction in accidents on the job site.

To uphold the general obligation provision, the Occupational Safety and Health Administration (OSHA) was established. Over the years, construction safety standards have been established for the workplace, and various legislative and administrative changes have added more requirements for employers to ensure worker safety. The general duty clause comes into play when there aren't specific standards in place, but a workplace hazard is identifiable and can be fixed. This article basically says that "each employer shall furnish to each of his employees' employment and a place of employment which are free from recognized hazards which are causing or are likely to cause death or serious physical harm to his employees." Although the general duty clause encapsulates the legislation's overarching objective, OSHA compliance officials usually utilize the specific safety requirements to evaluate how effectively employers are adhering to the law. Construction worker injuries can have serious, far-reaching implications (Berwald, S. (2008)). They not only lead to personal suffering for the injured workers but also result in construction delays and productivity losses for contractors, as well as increased insurance premiums. Additionally, construction injuries can lead to other consequences, such as revenue losses for project owners due to delays, and a drop in workforce morale.

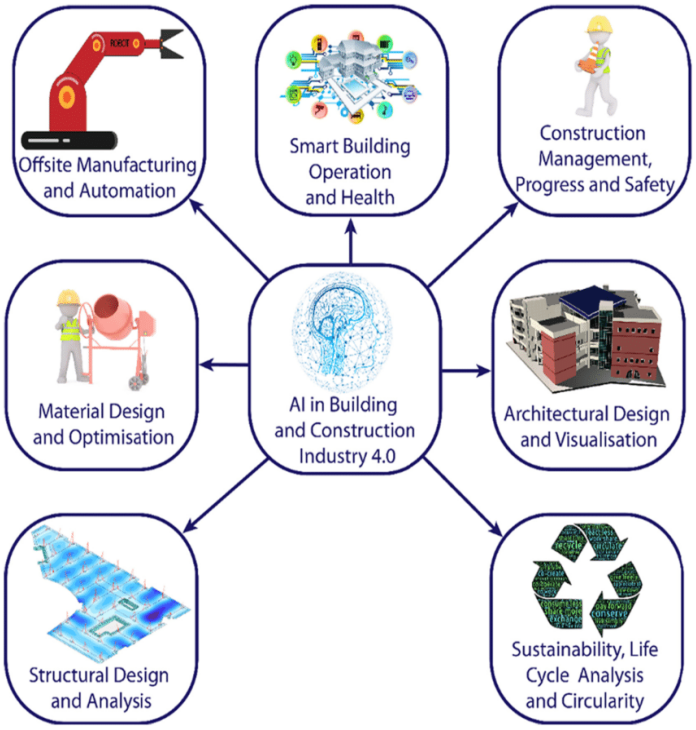

Fig. 1: Application of Automation

Review of Literature

Land and Tao (2011) highlighted how crucial it is to consider contingency when dealing with the unique risks faced by smaller construction firms. They closely examined how small and medium-sized construction enterprises manage risk and found that they are taking on greater business risk than the body of previous contingency literature would indicate. Meanwhile, Wang et al. (1999) examined the effectiveness of key contract clauses in projects that relate to political and force majeure risks. They pointed out areas where these clauses could be improved, particularly concerning approval delays, compensation issues, and changes in legal risks (Mahbub, 2008).

Bing et al. (1999) emphasized that design choices significantly affect job-site safety and identified various risk factors tied to international construction joint ventures from a holistic viewpoint (Paulson, 1985). By examining technical literature and consulting with industry professionals about current safety practices and theories, we can identify the right precautions to prevent accidents (Chen et al., 2018). The data we gather on past incidents will be crucial for our analysis, covering aspects like the type of construction, nature of the work, and specific accidents—such as falls, landslides, scaffolding collapses, and fires—along with the location and extent of damage. Since the existing literature on safety programs in construction is quite limited, we'll also look at studies from other industries. Additionally, we'll gather accident-related data through questionnaires, utilizing insights from our in-house construction management team during these reviews.

Materials and Methods

Since we're pulling data from past incidents, it's likely that more frequently encountered error types will have more cases, while rarer errors will show up less often. We aim to prepare this database using data from construction projects that have taken place in the last 15 years. The raw data we collect needs to be adjusted to fit our system. The accident graphics database is developed from this information, and we modify the raw data to align with current cases.

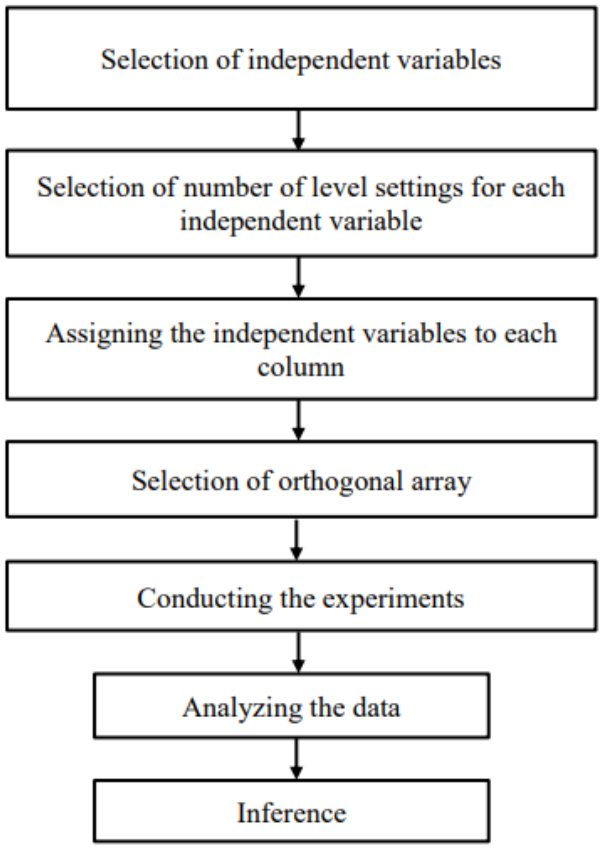

Fig. 2: Flow Chart of the Experimental Procedure

All communications and directives come from a single person who must be well-versed in the law and how it applies to the company's operations. We also identify similar cases and their attributes, matching each case with its corresponding attribute level. We compare each attribute with those in our case library and assign a similarity value between 0 and 1. To achieve our desired results and conclusions, we analyse the raw data collected from surveys on safety implementation and management practices in construction companies, using percentage calculations for 'yes' or 'no' questions (Castro-Lacouture, 2009). Additionally, we employ frequency analysis and relative index (RI) to assess responses regarding safety awareness, culture, implementation standards, compliance, enforcement, monitoring and control, safety improvement measures, and investments in safety.

The weights assigned to different features can vary depending on the type of accident. Additionally, not all features are relevant for every type of accident. There isn't a fixed algorithm for determining these weights; instead, they are established based on empirical data. Features that are more relevant to a specific type of problem receive higher weight values. The tasks mentioned above are intended for the safety program, which is designed to be easily expandable without needing to create new rules from scratch based on past incidents. Since the weights have already been established, we can add new cases to the database without having to adjust the feature weights. This expanded database will be tested against a new set of incidents to see if the feature weights hold steady as the number of incidents grows. One of the key strengths of this approach is that it draws on relevant past incidents for guidance in nearly every case, but it does require some judgment. To illustrate how this proposed methodology works, we will look at the following case study.

Discussion

While the previous suggestions have mainly concentrated on how construction companies can implement safety measures, the real challenge lies in capturing the interest and commitment of architects, engineers, and contractors (A/E/C). These professionals aren't always closely tied to the construction industry.

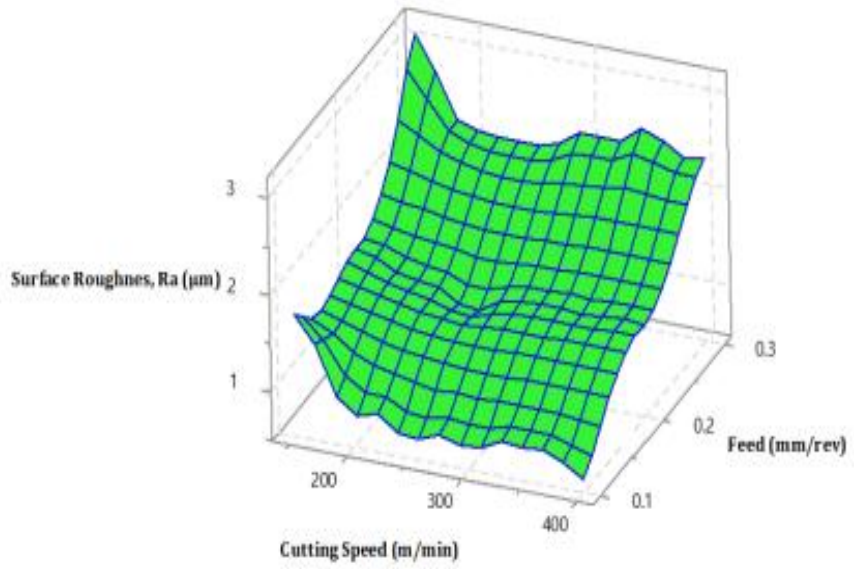

Fig. 3: 7 Surface Plot of Surface Roughness vs. Feed

Consequently, many traditional project designs often overlook the challenges that arise during construction, especially those concerning the safety of workers on site. It's crucial to engage A/E/C in efforts to uphold safety standards within the industry.

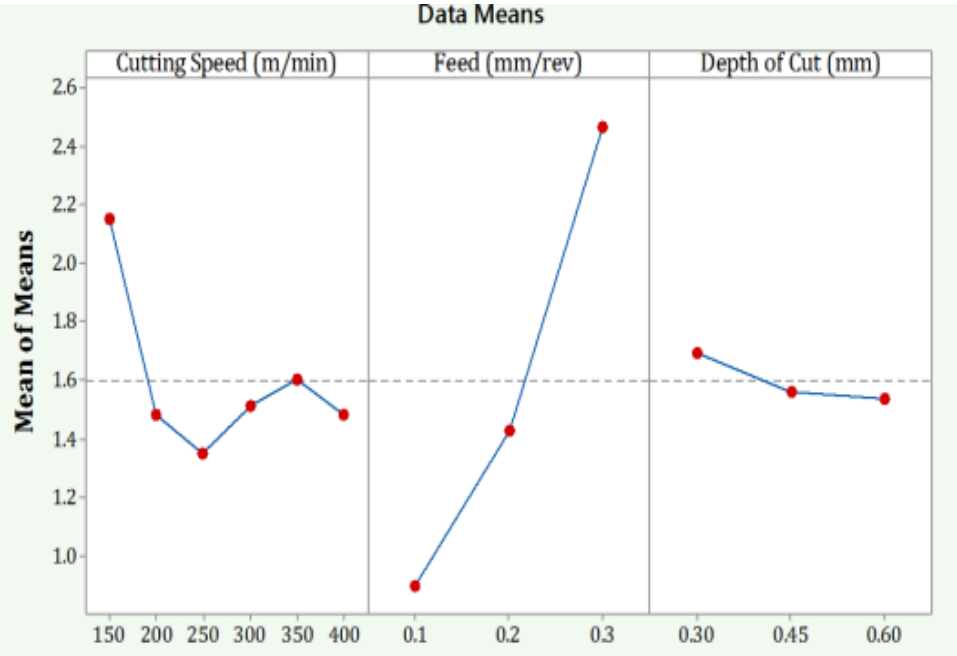

Fig. 4: Main Effects Plots for S/N Ratios- Surface Roughness

The methodology outlined in this section has examined a few cases, but more need to be gathered to create a comprehensive database (Oke et al., 2017). By adopting a case-based approach, we can identify similarities among different cases and apply those insights to new situations.

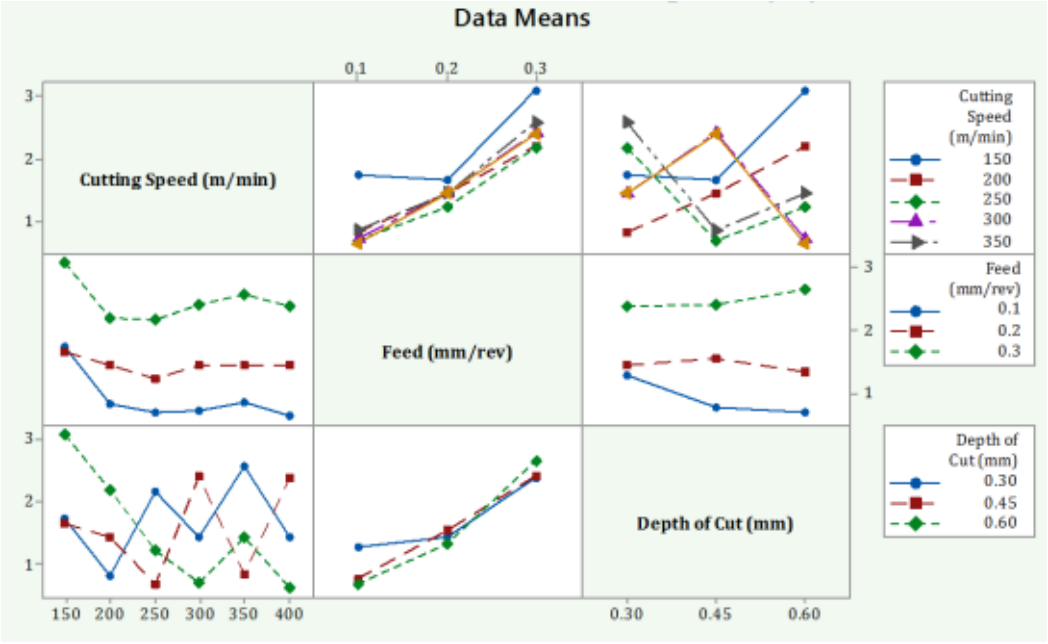

Fig. 5: Interaction Plots for Surface Roughness

They need to understand that the decisions made by designers can directly affect the safety of construction workers. Owners should also be aware of the increased risk of liability when it comes to injuries sustained by workers on site. Educated owners are likely to realize that designers must prioritize worker safety in their plans. If design firms are chosen based on how well they respond to owners' needs, then owners simply need to express their requirement for safety to be a priority.

Conclusion

A number of initiatives are being implemented by the construction sector to improve safety performance. Effective safety measures are the main focus of these programs, especially with regard to the rates of recordable injury incidents and lost time injury incidents. Here are some key takeaways from this effort. A significant number of accidents happen due to inadequate training for workers regarding their tasks. It's crucial for management to proactively identify and eliminate unsafe conditions. By promoting and reinforcing positive behavioural changes, we can significantly reduce the number of injuries and fatalities. Poor safety records can seriously hinder contractors' ability to run a profitable business. The role of owners in this process is incredibly important. This approach will lead to fewer injuries among construction workers and reduce the likelihood of lawsuits for owners. To truly enhance safety records, company management must take the lead and empower every employee to make impactful safety-related decisions. The negative consequences of accidents can lead to significant losses for contractors. A successful safety program requires careful planning and improved communication. Projects that prioritize safety are more likely to be completed on time and within budget.

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