ANALYTIC HIERARCHY PROCESS (AHP) MODEL OF THE MAIN FACTORS OF FIRE AND EXPLOSION ACCIDENTS IN CONSTRUCTION PROJECTS

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ABSTRACT

Fires and explosions are not the most common cause of injury to construction sites; such accidents can have devastating effects on workers' health. Out of 302 cases reported to the Department of Safety and Health (DOSH) from 2010 to 2019, about 0.33% of Malaysia cases are fire and explosion. It is discovered that the cause of death is inadequate supervision and lack of safety training, and the trade worker affected is construction labour. This paper developed an AHP model for fire and explosion accidents' significant factors and determined their relative weights and priorities. Worker's unsafe actions have a maximum weight of 80.98% for the significant factors based on the proposed AHP model, followed by unsafe site conditions with 10.89% and management factors with 8.13%. Financial constraint carries the most weight with 20.22% for management factors, unsafe working and operating procedure, presence of combustibles on-site, presence of an electrical hazard, improper on-site storage for flammables, and improper on-site storage of explosives for blasting with 14.28% each carry the most weight for unsafe site conditions. Rushing to complete the job and use of faulty or unsafe electrical equipment or machinery carry the most weight, with 17.24 % each for workers' unsafe actions.

Keywords: *Fire and Explosion, Factors and Sub-Factors, Analytic Hierarchy Process (AHP), Construction Projects*

RESEARCH HIGHLIGHTS

1. Fire and explosion can have devastating effects on the construction workers' health and safety.
2. This paper developed an AHP model for fire and explosion accidents' significant factors and determined their relative weights and priorities.
3. Worker's unsafe actions have a maximum weight of 80.98% for the significant factors based on the proposed AHP model.
4. The proposed approach is repetitive, allowing for changes and revisions to the weighting criteria and sub-criteria based on project type, company status, project location and other relevant variables.

Research Objectives

This paper's main objective is to develop an AHP model for fire and explosion accidents' significant construction factors and determine their relative weights and priorities. By using a defined process for selecting and prioritizing factors and sub-factors for fire and explosion hazards, small and medium-sized construction companies can make the most effective decisions to help them know the critical things, they need to minimize these types of accidents. The study considered small and medium-sized enterprises only because they account for more than 90% of Malaysia's registered construction companies (1). This study can help safety practitioners understand the factors and sub-factors responsible for fire and explosion accidents, and they can reduce the risk of fatal accidents on-site, and how they can make prompt safety decisions.

Methodology

AHP is used in decision-making in complex and critical situations where individuals work together to identify intangibles' impacts. It is fundamentally a way of measuring intangibles by pair-wise comparisons with judgments representing one factor's superiority over another to the property they share (2). One of the advantages of this process is that empiric comparisons can be transformed and compared to numeric values. The weight of each factor makes it possible to evaluate each of the elements within the defined hierarchy. However, expert judgments are rarely consistent when dealing with intangibles. For such types of decisions to be valid, consistent matrices must be created (3).

Results

Management factors, unsafe site conditions, environmental issues, and industry uniqueness are the leading causes of accidents in Malaysia's construction industry (4). Worker's unsafe actions have a maximum weight of about 80.98% for the significant factors based on the proposed AHP model, followed by unsafe site conditions of 10.89% and management factors of 8.13%. Unsafe site conditions can lead to a wide range of hazards and unsafe workers' actions at construction sites. Financial constraint carries the most weight with 20.22%, followed by incorrect or lack of standard work procedures, lack of proper and adequate supervision, lack of safety and enforcement regulations and a lack of risk assessment of 13.48% each for the management factors. Unsafe working and operating procedure, presence of combustibles on-site, electrical hazard, improper on-site storage for flammables, and improper on-site storage of explosives for blasting with 14.28% each carry the most weight for unsafe site conditions based on the proposed model. Rushing to complete the job and use of faulty or unsafe electrical equipment or machinery carry the most weight with 17.24 %, followed by failure to wear/inappropriate use of PPE, use of hazardous methods or procedures, improper handling of explosives for blasting and use faulty tool/equipment/PPE with 13.79% each for the workers' unsafe actions. It is found that improper use of PPE and faulty PPE is a significant factor of fatal accidents (5).

Findings

This study's main finding is that fire and explosion accidents are preventable on construction sites because most of them are due to management failure, unsafe site conditions, and unsafe worker actions.

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Author's Biography

I finished my master's degree in Construction Management in Civil Engineering from the University of Belgrade, the Republic of Serbia, in June 2013, and my undergraduate at Bayero University, Kano, Nigeria, in February 2008. My first degree is in General Civil Engineering (B.Eng. {Civil}). I lecture at Bayero University, Kano, Nigeria, department of civil engineering, faculty of engineering. I am currently doing my PhD at Universiti Teknologi PETRONAS, department of civil and environmental engineering. I have more than 10 years of working experience in construction management and over 7 years in teaching.