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Applied Technologies in Minimizing Accidents in Construction Industry

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Abstract

Economic potential and social benefits of new infrastructures construction contribute to the development and improvement of life comfort in Hong Kong. However, increasing fatal accident cases on construction sites associated with improper use of crane, call for further awareness and reflection on improvement of construction methods and safety precautions. This paper, throughout a review of existing research studies and literature, addresses construction overall occupational safety and health performance concerns in Hong Kong, and proposes new measures that may potentially contribute to prevent and minimize crane related accidents in construction industry. As a result, virtual prototyping software methodologies, widely diffused and applied in construction might significantly contribute to, not only improve the construction methodologies, but also avoid the main causes of fatal accidents, in particular, human error associated with inappropriate setting of construction methods, selection, placement and traffic of cranes; and localization /design of construction sites. Newly developed and applied technologies in automotive industry may serve as effective measures in reducing accidents and enhancing safety in construction industry.

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Keywords: Occupational accidents reduction; Construction industry; Virtual prototyping methodologies

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1. Introduction

Various infrastructure development programmes are being implementing in Hong Kong such as the new government buildings, express railways in linkage with mainland China, development and improvement of public roads, waterfront redevelopment in Central, West Kowloon, Victoria Harbor projects etc., that undoubtedly contribute to regional economic growth and prosperity. However, assuring occupational safety and health for workers during construction activities remain a critical challenge. One of related major safety concerns is cranes falling, that has become a worldwide major safety cross-cutting and challenging issue in construction industry. Experts in various fields are therefore proactively working on such critical aspect in order to avoid major causes of fatal accidents and enhance safety on construction sites. This paper aims at reviewing the main outcomes of existing research studies and abroad technological attempts, and coming up with applicable effective measures to overcome fatal accidents recurrence in Hong Kong construction industry.

2. Methodology

This paper is a succinct and short review of existing research studies, technical attempts and literature on worldwide construction safety enhancement. Selected company for case study is based on two criteria, such as representativeness (best practices and successful stories in terms of technology for accident rate minimization in construction site) and comparability (places with similar context as Hong Kong)

3. Literature Review

The Government of Hong Kong Special Administrative Regional (HKSAR), by implementing its infrastructure development programmes, drives vast and intensive construction activities in the city. However, increasing incidents, accidents and construction workers safety concerns, legal cases and prosecutions, judicial review processes, are drawing the attention of authorities and stakeholders involved in Hong Kong construction industry on the necessity of improving safety. According to the figures provided by the Labour and Welfare Bureau, the construction industry recorded 1,248 industrial accidents with an accident rate of 49.5 (per 1,000 workers) in the first half of 2009, representing a drop of 9.3% and 10% respectively in comparison with the figures in the same period of last year. Yet, the fatal industrial accident which happened at the International Commerce Centre further aroused public concern on safety in construction industry [1]. It is not surprising that major part of operation costs are consumed by safety and accident ratios. For most of foundation and site formation projects, mobile cranes are the most versatile material handling equipment and have received considerable attention from site management. Mobile cranes can provide fast combined vertical and horizontal distribution of materials to designated work areas and thus become indispensable and frequently used in construction sites. However, the number of mobile cranes available for construction sites is restricted to avoid clashing between cranes and maintain a low overall operating cost [2]. However, recent incidents associated with collision of tower cranes on construction sites have aroused Hong Kong Housing Authority's utmost concerns. Basically, contractors are responsible of safety on sites, and have absolutely to ensure construction safe workplace and take measures to carefully manage site operations to prevent accidents [3].

4. Findings

Inappropriate decision of types, distribution and traffic of cranes on construction sites may lead to major drastic damage and accidents and significantly affect construction overall occupational safety and health performances. Based on desktop reviews and information provided by literature review, all construction sites are required to utilize virtual prototyping for crane selection and placement. Virtual prototyping software methodologies can help to avoid the major human error associated with inappropriate setting of construction methods, selection and driving of equipment /machines; and localization /design of construction sites. The inherent uncertainty and complexity of construction works make construction planning a particularly difficult task for project managers due to the need of anticipation and prediction. Conventional computer-assisted technology may be therefore helpful. However, the technology is often limited by the constructability issues. Virtual prototyping, however, offers an improved method through the

visualization of construction activities by computer simulation, by enabling a range of 'what-if' questions to be asked and their implications on the whole project [4]. Virtual prototyping is a method conceived for product development sector that involves various software (computer-aided design, computer-automated design and computer-aided engineering) for design validation prior to physical prototype settings. This process might not only significantly reduce costs, but also reduce safety hazards by implementing what-if scenarios before, during and after selection and operation of cranes. In short, providing this type of potential reform for crane selection, placement and operation process on all new construction sites in Hong Kong, will gratify the Labor Department for the reduction of crane related accidents over the course of all new construction schedules.

5. Industry Case Study

Although manufacturing and construction may appear at completely opposite ends of a spectrum, the automobile industry provides an excellent example of the benefits for implementing virtual prototyping software assessment programs and methodologies. Automotive giants like Ford and General Motors have conceived and designed virtual prototyping software methodologies for low cost operations. For this purpose, a state-based object model that creates a virtual car body assembly line is proposed with a verification methodology using observed signal sequences for simulation [5]. Undoubtedly, this approach will become an industry standard in the near future.

The process of virtual prototyping not only reduces costs and improves quality, but also reduces replacement options. As partnerships are developed for the process of 'Just-In-Time' delivery, other suppliers involved in the system have found that virtual programs can enhance business partnerships by creating virtual finished products with the past expense of actual building working prototypes. It should be thus easy for parts suppliers and actual manufacturing facilities to be strategically located as internet enables smooth transition of innovative ideas and processes through virtual design implementation. Integrating of such system in Hong Kong construction industry in partnership with key worldwide stakeholders, might significantly improve construction efficiency and safety.

6. Conclusion

Technological innovation in automotive industry can serve as excellent examples in reducing accidents and enhancing safety. Application of virtual prototyping software methodologies will undoubtedly contribute to overcome critical challenging safety and productivity performance issues. Between 2004 and 2008, the Court heard 61 summonses of prosecution taken by Labor Department against workers for contravention of occupational safety and health legislation on construction sites [1]. These convictions in many scenarios might be properly prevented with the implementation of virtual prototyping software for all new infrastructure construction programmes in Hong Kong. All stakeholders involved in Hong Kong construction industry are therefore recommended to closely work in such flourishing direction.

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