
Original Research Article

Research on lifting risk management and emergency strategies

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Abstract: This paper aims to study lifting risk management and emergency strategies to enhance the safety and efficiency of lifting operations. Using case analysis, it summarizes risks and lessons learned from actual cases and proposes corresponding management and emergency strategies. The findings indicate that establishing a comprehensive risk assessment and management plan, training operators, and setting up emergency response procedures are effective measures for lifting risk management and emergency response.

Keywords: Lifting; Risk management; Case studies; Emergency strategies

1. Introduction

Lifting operations are high-risk activities that involve complex dynamics among lifting equipment, rigging, and operators. Therefore, research on lifting risk management and emergency strategies is crucial. Effective risk management can reduce the likelihood of accidents, while agile emergency strategies can minimize damage resulting from incidents. This paper will explore lifting risk management and emergency strategies through case analysis.

2. Case Analysis of Lifting Accidents

Lifting operations are common in various industrial and construction sectors, with increasing demand driven by urbanization and infrastructure projects. Despite advancements in lifting technology, safety concerns remain paramount. Lifting heavy loads improperly or lacking safety measures can lead to accidents and casualties. For example: In 2008, at a construction site in China, a heavy steel beam fell during lifting due to inadequate safety measures, injuring and killing multiple workers. The investigation revealed that operators failed to use the correct lifting equipment and lacked necessary training. In 2016, a port in the United States experienced a lifting accident where a large crane toppled while lifting containers, resulting in fatalities. The accident was attributed to structural instability and improper judgment regarding center of gravity. In 2019, at a pharmaceutical factory in the UK, a heavy piece of equipment shifted during lifting, leading to a partial collapse without injuries. The incident stemmed from insufficient planning and emergency measures. The 2000 London suspension bridge incident involved two cranes during bridge installation, where a leg failure led to tipping, demonstrating poor fault recognition and handling. In 2014, a dual-crane lifting operation in North America suffered an accident due to communication failures, causing synchronization issues and equipment loss.

Common Causes of Lifting Accidents. Analysis of these cases reveals several primary causes of lifting accidents:

- Equipment Issues:** Design, manufacturing, and maintenance flaws, such as structural fatigue and material quality issues.
- Operational Errors:** Insufficient experience and training of operators, leading to improper execution of procedures.
- Regulatory Violations:** Non-compliance with lifting operation standards, including inappropriate equipment selection and overload operations.
- Poor Planning:** Lifting procedures that inadequately consider load variations and environmental conditions.
- Environmental Factors:** Uncontrollable elements like natural disasters and severe

weather affecting operations. Communication Gaps: Lack of coordination and communication among personnel and equipment leading to operational conflicts. Inadequate Load Analysis: Failure to assess lifting loads and center of gravity accurately, resulting in overloading or imbalance. Management Failures: Ineffective management and safety culture, leading to unaddressed safety concerns. Human Factors: Fatigue, distraction, and rule-breaking behaviors increasing accident risks.

3. Risk Management and Emergency Measures

To address the issues identified, the following measures are proposed: Comprehensive Risk Assessment and Management Plan: Conduct thorough risk assessments of the work environment, equipment, and personnel to identify potential hazards. Develop corresponding risk management measures, including engineering controls, personal protective equipment, and behavioral norms. Regularly review and update risk management plans to adapt to changes. Operator Training: Provide comprehensive training and education to ensure operators possess the necessary skills and knowledge about equipment operation and safety requirements. Emphasize safety awareness and response capabilities through regular drills and simulated training. Emergency Response Procedures: Establish emergency response protocols covering alerting, evacuation, first aid, and investigation processes. Designate a professional emergency response team with the knowledge and skills to handle lifting accidents, and conduct regular emergency drills to test the effectiveness of procedures. Regular Equipment Inspection and Maintenance: Implement routine checks and maintenance of lifting equipment to ensure operational safety. Maintain records and promptly repair or replace damaged parts, including emergency spare parts for quick repairs. Enhanced Communication and Collaboration: Strengthen communication and coordination among all parties involved in lifting operations. Establish effective channels for timely information exchange and experience sharing. Foster cross-departmental collaboration to jointly manage risks and emergency situations.

4. Future Development Trends and Technological Innovations

With the continuous advancement of technology, the lifting industry is experiencing a series of innovative technologies and development trends that will significantly enhance the safety and efficiency of lifting operations.

Firstly, the widespread adoption of intelligent equipment is a major trend for the future. By integrating sensors and IoT technology, modern lifting equipment can monitor the working environment and equipment status in real time. For example, cranes can detect load, wind speed, and other environmental factors through sensors, automatically adjusting operational parameters. This intelligence not only improves safety but also reduces human error and enhances operational efficiency.

Secondly, the application of unmanned operations and automation technology is gradually becoming a reality. Drones and automated lifting systems can replace manual operations in hazardous environments, effectively reducing accident risks. Additionally, these technologies can perform precise lifting in complex work settings, ensuring both efficiency and safety. As these technologies mature, the possibility of fully realizing unmanned operations will continue to increase.

Moreover, the combination of big data and artificial intelligence offers new perspectives for risk management. By analyzing historical data, companies can identify potential risks and develop corresponding preventive measures. Machine learning algorithms can help predict equipment failures, allowing for proactive maintenance and reducing the likelihood of accidents. Furthermore, data analysis can optimize lifting operation planning, improving resource utilization.

Additionally, the use of augmented reality (AR) and virtual reality (VR) technologies in training and operational guidance will greatly enhance work efficiency. By simulating lifting environments, employees can practice in a safe virtual setting, improving skill mastery. This technology not only reduces training costs but also allows effective emergency drills before new employees start working.

Finally, sustainable development and environmental protection technologies are gaining increasing attention. Using low-emission and energy-efficient equipment in lifting operations not only meets environmental policy requirements but also enhances corporate social responsibility. In the future, the development of green lifting technologies will provide new momentum for the industry's sustainable development.

5. Conclusion and Future Outlook

This study has analyzed lifting accident cases to investigate lifting risk management and emergency strategies. It concludes that establishing a comprehensive risk assessment plan, training operators, and implementing emergency response procedures are effective measures. These findings provide valuable guidance for professionals and managers in the lifting industry, enhancing safety and efficiency while reducing accidents.

Despite the thorough exploration of lifting risk management and emergency strategies, limitations remain. Future research could investigate innovative lifting risk management techniques and evaluate their effectiveness. Additionally, integrating modern technologies such as IoT and AI could facilitate the development of intelligent lifting risk management systems for real-time monitoring and response.

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