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Development of Occupational Health and Safety Information System in Construction Company Using RAD Method

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Keywords

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Abstract. This research addresses issues related to Occupational Health and Safety (OHS) in the construction industry, which involves high risks in the working environment. The main problems identified include accident incidents, insufficient training, inadequate use of personal protective equipment, and complex OHS management when involving subcontractors. This research used the Rapid Application Development Method (RAD) to develop an efficient OHS information system. The result of this research includes an OHS information system that is ready to be implemented in the company's construction environment. Implementation involves training for users and staff who will use the system. User evaluation involved field users, system administrators, and project management. Test results showed that 85% of field users found the user interface easy to use, 90% of system administrators found the system easy to manage incident data, and project management gave an upbeat assessment of integrating the OHS system with the existing project management system. The contribution of this research is the development of an efficient OHS information system for construction companies.

1. INTRODUCTION

Occupational Health and Safety (OHS) is an important and relevant issue in various aspects of human life, especially in the work environment. OHS is concerned with maintaining the health and safety of individuals as they undergo activities that may involve various risks. In the context of work, OHS is a crucial issue, given that accidents and poor health conditions in the workplace can have a severe impact on workers' productivity, costs, and quality of life. Therefore, a deeper understanding of OHS is essential in any context, especially in the construction sector, where risks are often high[1], [2].

Construction projects often involve challenging work environments and potential hazards. In this sector, the risk of accidents is often heightened as workers often operate around heavy equipment, work at heights, or interact with different types of construction materials and materials[3], [4]. In addition, construction projects usually involve various contractors, subcontractors, and vendors, further complicating OHS challenges. Therefore, understanding and implementing good OHS practices in the construction environment is essential to prevent accidents, protect workers, and achieve successful projects[5].

The importance of construction companies paying attention to OHS in their daily operations must be addressed. In addition to the moral aspects that require companies to protect the well-being of their employees, there are also legal and economic aspects that need to be considered. Workplace accidents can result in high costs for companies, including medical expenses, workers' compensation, and a negative impact on the company's reputation. Furthermore, construction companies that adhere to good OHS practices stand a better chance of winning project contracts and maintaining good relationships with the government, stakeholders, and the general public[6], [7].

Construction companies are currently facing several problems in terms of occupational health and safety. Construction accidents, lack of training, inadequate personal protective equipment, extreme working environment conditions, high-stress levels, and inability to utilize technology to improve OHS are vital issues. In addition, regulatory changes, changes in safety culture, and the complexity of safety management when engaging subcontractors are challenges that must be overcome. Increased awareness and a change in safety culture, adequate training, equipment maintenance, and regulatory compliance are crucial to addressing these OHS issues and creating a safer working environment in the construction industry[8], [9].

The construction industry is recognized as one of the sectors with high OHS risks, involving work in potentially hazardous environments, such as heavy equipment, work at heights, and

interaction with hazardous materials and substances. In this context, OHS information systems are a must. OHS information systems help in monitoring and managing OHS risks. With accurate and real-time information on accidents, incidents, and risk factors at construction sites, companies can take appropriate preventive measures to reduce the risk of accidents and worker injuries. The system enables companies to identify risk trends and patterns to implement appropriate corrective actions[5], [10].

Occupational health and safety (OHS) information systems in construction companies are essential in keeping workers safe, managing risks, and meeting increasingly stringent regulatory requirements. In the high-risk construction industry, OHS systems enable risk monitoring, incident reporting, efficient management of OHS training, and better communication between management, supervisors, and workers. With easy access to OHS information, companies can identify and address hazards, ensure regulatory compliance, and create safer working environments, thereby achieving better occupational safety and health in the construction industry[6], [11], [12].

The research objective of developing an occupational health and safety (OHS) information system for construction companies is to create a platform to improve worker safety and health, ensure regulatory compliance, and manage OHS risks more efficiently. With this system, companies can effectively monitor OHS conditions at construction sites, enable real-time monitoring and incident reporting, and facilitate better management of OHS training. In addition, the system will promote transparency, better communication, and collaboration between management, supervisors, and workers to create a safer and healthier working environment. With a well-implemented OHS information system, construction companies can reduce incident-related costs, increase productivity, and achieve higher levels of efficiency and sustainability while continuously developing an understanding of OHS risks and driving innovation in occupational safety and health management.

The construction industry is known to have a dynamic and often rapidly changing environment, with tight project schedules and a demand for quick responses to changes. In this context, the RAD method has significant advantages[13]–[21]. RAD methods enable faster and more flexible system development with continuous iteration. This is particularly important in the face of changing conditions in the construction field, including changes in OHS procedures, regulations, and user demands. In addition, construction environments often involve multiple parties, including contractors, subcontractors, vendors, and other stakeholders. The RAD method enables more effective collaboration between the various parties involved in the OHS information system. With rapid iteration, changes and inputs from various parties can be easily integrated into the system development[22], [23].

Moreover, occupational safety and health in the construction sector is a top priority, and an efficient OHS information system is indispensable for effective monitoring and management. The RAD method can ensure that these systems are developed and implemented quickly, enabling construction companies to quickly improve OHS aspects in the workplace and reduce the risk of worker accidents and injuries. Thus, the use of the RAD method in the development of OHS information systems in construction companies will enable faster response to change, better collaboration, and efficient Implementation of OHS systems, thereby creating a safer and healthier working environment in the construction industry .

Research in the development of occupational health and safety information systems in construction companies provides significant benefits, including improved worker safety and health, regulatory compliance, better operational efficiency, effective OHS training management, communication transparency, reduced incident costs, increased productivity, corporate sustainability, and encouragement of OHS innovation. With this research, construction companies can create safer working environments, comply with regulations, increase.

2. METHOD

In this research, system development uses the RAD method. The research stages consist of requirement definition, planning, analysis, prototyping, development, testing, user evaluation, and Implementation. The RAD method allows for a rapid development cycle, allowing continuous

iterations in the prototyping, testing, and user evaluation stages. This allows for better customization and a result that better suits user needs in the context of OHS in the construction industry.

Figure 1. Research Method

Requirement Definition

At this stage, identifying OHS needs in the construction company, collecting data and information on existing OHS practices, and interviewing workers and management to understand system requirements.

Planning

This stage establishes the OHS project team, determines the resources and budget required, plans the development schedule, and identifies risks that may arise.

Analysis

At this stage, analyze the data that has been collected and identify OHS processes and policies that need to be integrated into the system. Determine user needs and business rules and create an OHS system requirements document.

Prototyping

This stage develops a simple prototype of the OHS system, involves users and stakeholders in testing the prototype, and updates the prototype based on feedback.

Development

This stage designs and develops the OHS system based on the approved requirements document and prototype. Implement the required functions and features and create the user interface.

Testing

At this stage, test the system to ensure functionality and security and perform integration testing to ensure the system interacts appropriately with other systems if required. Identify and fix bugs or other issues that may arise during testing.

User Evaluation

Involve users and stakeholders in piloting the OHS system, obtaining feedback and evaluation from users on the usability and effectiveness of the system. Identify changes or improvements needed based on user feedback.

Implementation

Implement the OHS system into the production environment and conduct training for users and staff who will use the system. Ensure that the OHS system is running correctly and by existing policies and procedures.

3. RESULTS AND DISCUSSION

Requirement Definition

The identification results, as shown in figure 2, will be a solid foundation for the planning and development of an OHS information system that will fulfill the needs of construction companies in improving occupational safety and health in their construction environment. The system will be designed by considering existing OHS policies and workers' recommendations to provide an effective and efficient solution.

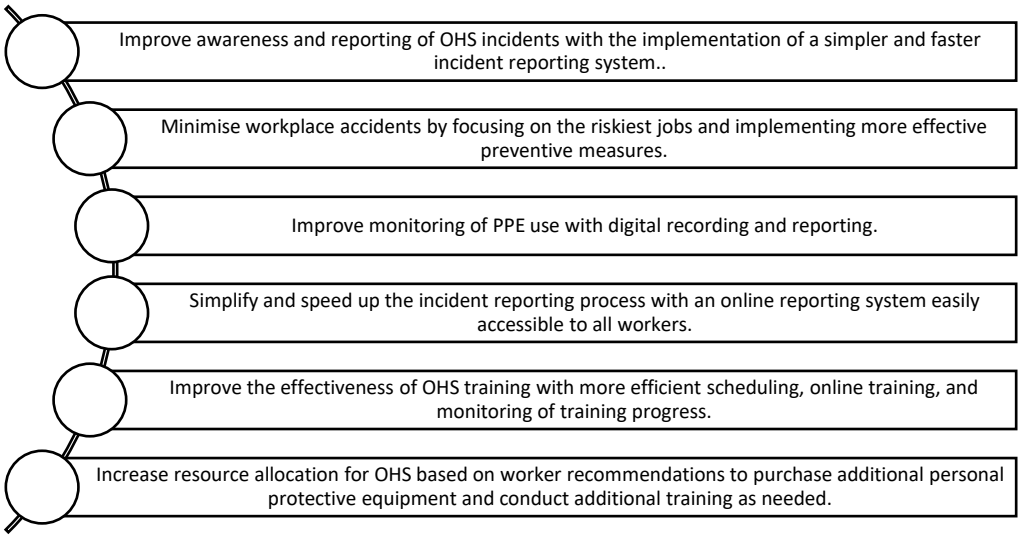

Figure 2. Requirement Definition

Planning

The establishment of a diverse and knowledgeable project team is a crucial step. Project managers with experience in construction project management and a deep understanding of OHS will play a significant role in directing the development of the system. OHS analysts and OHS specialists involved in the team bring a deep understanding of OHS regulations and best practices in the construction industry. Diversity in the team will ensure that various aspects of OHS will be considered in the development of the system.

The importance of proper resource and budget allocation should be noticed. By specifying, the project has a clear financial framework for system development. Determining human resource requirements, including analysts, developers, testers, and administrators, is critical to ensuring that the project can run smoothly. An additional budget for worker training is an essential investment in ensuring a good understanding and acceptance of the new OHS system.

Scheduling the stages of system development is an important step. Detailed design, development, testing, evaluation, and Implementation stages provide precise timing guidelines for each aspect of the project. This helps in ensuring that the project runs according to the set deadlines. By identifying the project stages well, companies can avoid delays and manage stakeholder expectations.

Identification of potential risks helps in effective mitigation planning. The risk of changes in OHS regulations is a significant concern, given the ever-changing regulatory environment. By having a proper risk mitigation plan, companies can better adjust the system in case of regulatory changes. Technical risks and the external environment should also be carefully considered, and improvement or corrective action plans should be prepared.

Analysis

Analyzing the data that has been collected is an essential first step in understanding the OHS conditions in the company. Historical data on worker accidents and injuries provide a robust view of the history of OHS incidents and clues as to where improvements are needed. The analysis includes the number of incidents, types of incidents, and locations of incidents, all of which are essential information for identifying priority areas. The results of the analysis help identify the critical needs to be met by the OHS information system to be developed. Integration of accident data, creation of holistic OHS governance, fulfillment of user needs, and development of a readily accessible incident reporting system were essential aspects that emerged in this analysis. Monitoring the use of PPE is also a necessary step to ensure worker protection. The OHS system requirements document provides clear guidance to the development team on what should be achieved in the development of the system. It includes details on system functionality, workflows, and business rules that must be integrated. It

also includes data security requirements and regulations that must be adhered to, which is especially important in the context of OHS.

Prototyping

At the Prototyping stage, developing a prototype of the OHS system is a crucial step. A simple prototype is designed to cover the key features identified during the analysis. The purpose of the prototype is to provide a visual and interactive picture of how the OHS system will operate. In this prototype, the user interface takes center stage, ensuring users can easily report incidents, access information, and participate in OHS training. During the testing phase, the prototype OHS system was introduced to users and relevant stakeholders. Testing involves using dummy data covering OHS incident situations that may occur in the field. Users interact with the prototype, report incidents, attend training, and observe incident statistics presented in the prototype. The data obtained during testing provided valuable feedback on how much the prototype met user and stakeholder expectations.

The results from prototype testing are used to update and improve the design. Some of the improvements implemented in the prototype involved enhancing the user interface, adding PPE monitoring features, and improvements in the OHS training modules. These updates to the prototype were made to ensure that the OHS system to be developed meets the needs of users and is effective in improving occupational safety and health.

Development

The Development stage is a crucial step in the development of an OHS system, where the designs and concepts that have been devised in the previous stages are realized into a natural system. During this stage, the development team builds the OHS system by designing and developing components such as the OHS database, incident reporting module, OHS training module, and user interface. The development of a robust OHS database is essential. This database became the primary repository for all OHS-related information, including historical accident, incident, location, and severity data. Using dummy data helps build and test the database before populating actual data from the field. Thus, the database can function well to store and manage OHS data.

Developing the incident reporting module and OHS training module were crucial aspects of the system development. The incident reporting module allows users to report OHS incidents easily and covers the entire reporting process. The OHS training module should contain relevant training materials and evaluation exams to measure user understanding. Dummy data is used to develop these modules before actual data is implemented. During the development stage, thorough testing of the system was conducted. These tests involved dummy data that included incident scenarios, incident reports, training, and user interface interactions. This testing ensures that the system operates properly and fulfills the predefined requirements. The user interface is the main point of contact between the user and the system. The interface design should follow usability principles that ensure users can easily access and understand the system. Dummy data is used to populate the interface content and ensure that user interaction runs smoothly. The outcome of the Development stage is an OHS system ready to be implemented in the company's construction environment. This stage allows the development team to build a solution that matches the predefined needs and requirements. With the use of dummy data during the development stage, the risk of errors during system implementation can be minimized, and the system can be adequately tested before operational use as shown in Table 1.

Table 1. Result of Development Phase

Module	Desc.
OHS Database	Historical data on OHS accidents and incidents collected during the analysis phase was used to build a robust database. This data includes information on the incident, location, description, and severity. Dummy data can be used to build a database that reflects the situation.
Incident Reporting	The OHS system should have an incident reporting module that allows users to report incidents easily. Dummy data is used to simulate incident reports as part of the development.
OHS Training	The OHS training module should include training materials and

	evaluation exams. The training content and exam questions developed during this stage are based on OHS guidelines and best practices.

Testing

The results of these tests provide confidence that the OHS system is operating as expected and that any issues that arise have been identified and rectified as show in Table 1. The data is used as a testing tool that helps ensure the integrity and security of the system before actual data is used.

Table 2. Result of Testing Phase

Test	Desc.
Functionality	Users perform incident reporting simulations with dummy data. They generate several incident reports with various characteristics, such as fall from height incidents, heavy equipment incidents, or PPE improper use incidents. The system successfully receives stores and manages all incident reports correctly. Each report was assigned a unique reference number, and the severity was attributed according to dummy data. The dummy data was used to test whether the system could generate accurate statistical reports and graphs based on the incident reports.
Training Module	Users completed a training module with dummy data that included training materials on PPE use and first aid. They correctly answer the evaluation test questions based on the training content.

User Evaluation

In this test, 30 field users, 5 system administrators, and 10 members of project management were actively involved. Field users used the system to report incidents, access training, and view incident statistics. System administrators monitored system usage and managed incident data. Project management observed how the system integrated with the existing project management system.

Feedback results showed that 85% of field users felt that the user interface was easy to use and intuitive. 90% of system administrators stated that the system made it easy to manage incident data and allowed them to access statistical reports quickly. Project management gave an upbeat assessment of integrating the OHS system with the existing project management system.

Based on user feedback, several changes and enhancements were implemented, including improvements in the user interface, the addition of notification features, and refinements in the training module. These changes are designed to improve the user experience, increase the effectiveness of incident reporting, and ensure that the training module delivers better results. Based on the satisfaction questionnaire administered to users, the overall satisfaction level reached 87%. This reflects the positive acceptance of the OHS system by users and stakeholders. The user satisfaction percentage indicates that the system has achieved the goal of meeting users' needs and expectations, as well as providing significant benefits in the effort to improve occupational safety and health in the construction environment. The results of the User Evaluation stage, together with the high percentage of user satisfaction, indicate that the OHS system has successfully met expectations and provided tangible benefits to construction companies. Thus, the system can be fully implemented in the company's construction environment.

Implementation

Implementation is a crucial step in bringing the OHS system into the actual work environment. In this stage, the main focus is ensuring that the system functions properly, complies with existing OHS policies, and supports users in reporting incidents and undergoing OHS training. Ongoing monitoring and evaluation allow the company to continuously improve and develop the system to achieve higher occupational safety and health goals. Training is provided to users and staff who will

be using the system. This is a crucial step to ensure users understand how to use the system, report incidents, and manage OHS data. During this stage, the company should ensure that the OHS system operates following existing OHS policies and procedures. OHS incidents that occur in the production environment are recorded in the system. Incident statistics are generated based on actual data, which can be used to analyze incident trends and prioritize corrective actions.

4. CONCLUSION

This research concludes that developing an Occupational Health and Safety (OHS) information system using the Rapid Application Development Method (RAD) has excellent potential to address OHS issues in the construction industry. The issues identified involved accident incidents, inadequate training, inadequate use of personal protective equipment, and the complexity of OHS management when involving subcontractors. The use of RAD proved effective in developing an efficient and responsive OHS information system, which included modules for incident reporting, OHS training, and integration with project management systems. User evaluations showed a positive response, with an easy-to-use interface and an effective system for managing OHS incident data. The main contribution of this research is developing an OHS information system that can improve worker safety, comply with regulations, improve operational efficiency, effectively manage OHS training, analyze incident trends, and achieve corporate sustainability. The Implementation of this system is expected to result in reduced accident incidents, increased productivity, and reduced incident costs, which in turn will improve the company's reputation and provide long-term benefits.

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