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A Study on and Analysis of Hazardous Chemical Warehouse Construction Project Management System

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The author explores the management model of the hazardous chemical warehouse construction project. Through the construction of the evaluation model, the author divide the risk factors that may be encountered in engineering project management work, constructs a management system and introduces the main functional modules. Through the traditional risk model and the conditional risk model, the author obtains a hierarchy-based analysis and evaluation model and the management system in a safety situation. The construction of the management system effectively improves the utilization rate of chemical storage and reduces the risk of disordered management.

1. Introduction

With the level of industrialization in China continues to increase with the development of the economy, the demands for hazardous chemicals have also been increasing. However, it is noteworthy that the management level of construction projects has not reached a proper level. Safety incidents are frequent in the management of various construction projects, resulting in casualties and economic losses. The management of hazardous chemicals in China is not standardized, the service functions are simple and the waste of resources is common, which directly or indirectly leads to various problems. At present, most of the construction project management systems in China are too dependent on manual operations, which is not only ineffective in efficiency, but also with low intelligence, high cost and human resources and the possibility of accidents caused by improper manual operations is also high. Therefore, it is crucial to build a sound project management system.

In this paper, the author focuses on identifying the influencing factors in the project management system for hazardous chemical warehouse construction and the priorities of hazardous chemical warehouse project management in light of past cases, so as to determine their importance more rationally, and then the author designs an evaluation system combining the ideas of software engineering and proves the correctness of the management results and the feasibility of the system by using the realization algorithm. Then the author introduces the functional modules of the system, including information management, system management and evaluation management as well as the basic functions of the module.

2. Literature review

With the rapid development of the Internet of Things, new technologies are widely used in information system for improving the ability of administration. The storage of dangerous chemicals is an important stage in the whole process management of hazardous chemicals. This paper is targeted to outdated management approach in warehousing of hazardous chemical with higher risk, presents a monitoring and warning system based on internet of Things. By means of integrated detection nodes with parametric integration, this system realizes monitoring data collection in warehousing of hazardous chemical. Based on RFID and QR code, warehouse management is promoted on alarming store excess, illegal shipment and storage taboo, which is contributed to improving management level and avoiding safety risk in warehouse of hazardous chemical. By the data exchange and communication, the system can be applied to accident prediction, chemical logistics monitoring, government supervision and emergency rescue (Brown et al., 2015). The production of chemicals

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including hazardous chemicals are getting lager, strengthening the safety management is particularly important. The existing management status of hazardous chemicals in production, operation, transportation, storage, use etc. and the problems that exist in safety management of hazardous chemicals were analysed. And countermeasures to improve the safety management of dangerous chemicals warehouse were proposed, namely the layout of dangerous chemicals industry should be adjusted reasonably, great importance should be attached to the management of major hazard sources and emergency rescue, the early warning system and supervision system should be established and improved (Kabak and İbrahim, 2018).

Volatile organic compounds (VOCs) emitted and the microbiological content of the fuel was also determined. Knowledge of the hazards associated with these fuels, including confined space entry, was found to be limited at the smaller sites, but greater at the large pellet warehouse. There has been limited risk communication between companies supplying and maintaining boilers, those manufacturing and supplying fuel, and users. Risk is controlled by restricting access to the store rooms with locked entries; some store rooms have warning signs and carbon monoxide alarms. Nevertheless, some store rooms are accessed for inspection and maintenance. Laboratory tests showed that potentially dangerous atmospheres of carbon monoxide and carbon dioxide, with depleted levels of oxygen may be generated by these fuels, but this was not observed at the sites visited (Simpson et al., 2016).

Wireless sensor networks have profound effects on many application fields like security management which need an immediate and fast system reaction. Indeed, the monitoring of a dangerous product warehouse is a major issue in chemical industry field. This paper describes the design of chemical warehouse security system using the concept of active products and wireless sensor networks. A security application layer is developed to supervise and exchange messages between nodes and the control centre to prevent industrial accident. Different security rules are proposed on this layer to monitor the internal state and incompatible products distance. If a critical event is detected, the application generates alert message which need a short end to end delay and low packet loss rate constraints by network layer. Thus, a QoS routing protocol is also developed in the network layer. The proposed solution is implemented in Castalia/OMNeT++ simulator. Simulation results show that the system reacts perfectly for critical event and can meet the QoS constraints of alert message (Zouinkhi et al., 2015).

There is growing use of wood pellet and wood chip boilers in the UK. Elsewhere fatalities have been reported, caused by carbon monoxide poisoning following entry into wood pellet storage areas. The aim of this work was to obtain information on how safely these two fuels are being stored in the UK. Site visits were made to six small-scale boiler systems and one large-scale pellet warehouse, to assess storage practice, risk management systems and controls, user knowledge, and potential for exposure to dangerous atmospheres. Real time measurements were made of gases in the store rooms and during laboratory tests on pellets and chips (Arfaoui and Akaichi, 2014). Toxic industrial chemicals induce liver injury, which is difficult to diagnose without invasive procedures. Identifying indicators of end organ injury can complement exposure-based assays and improve predictive power. A multiplexed approach was used to experimentally evaluate a panel of 67 genes predicted to be associated with the fibrosis pathology by computationally mining DrugMatrix, a publicly available repository of gene microarray data (Shamasunder and Morello-Frosch, 2016).

Monitoring of five distance of hazardous chemicals storage warehouse stacking (distance, pile wall distance, zenith distance, spacing and channel spacing) is an important topic in dangerous goods warehouse safety supervision. Studying high precision positioning technology of dangerous goods stacking, is the premise of automately monitoring stacking safety. In this study, the main factors affecting the accuracy of UWB positioning of dangerous chemicals storage are analysed, and an UWB four reference vectors compensation method applied on dangerous chemicals warehouse stacking positioning is proposed. Firstly, a reference system is established, and the monitoring area is divided into rectangular grids, each vertex of grids is named as a reference point, then the error vectors UWB positioning values at the reference points are obtained, and are took as the reference vector to calibrate the target points; Secondly, UWB tags are attached to dangerous chemical goods stacking, searching the grids around the tags, and calibrating the position value of the tags by the UWB four reference vectors compensation method. Finally, the corrected coordinates are considered as the final position of stacking. The experiment showed that this method can effectively improve the positioning precision of the dangerous chemicals warehouse stacking, it is suitable for monitoring the five distance of hazardous chemicals warehouse stacking (Ferrada et al., 2016). A tool for the quantification of the consequences of toxic dispersions coming from fires in warehouses has been developed. This tool is expected to be applied in the framework of the risk assessment in Catalonia, specifically in the Quantitative Risk Assessment. The present study is based on the criteria gathered in the technical guide BEVI 3.2 and the methodology CPR-15 used in the Netherlands. Hence, the approach performed accepts the main body of the foresaid methodology but implements a different and free source dispersion model, a modified Gaussian model that considers the warehouse effect (Seguí et al., 2014).

This paper integrated the technical advantages of the Internet of things and the characteristics of hazardous chemicals storehouse and set forth the application of Internet of things technology in safety management of hazardous chemicals warehouse from aspects of fire prevention and control, law enforcement supervision and inspection, firefighting and rescue respectively to reduce the hidden hazards and improve the fire safety management level of same type of warehouse.

3. Methodology

3. 1 Positioning of hazardous chemical warehouse management

Hazardous chemical warehouse is the place where dangerous goods such as flammable, explosive, toxic and hazardous materials are stored and kept. Hazardous chemical warehouse is an important part of its logistics industry. It has two distinctive features: high professionalism and high risk. The storage of hazardous chemicals is different from other ordinary cargo storage. Due to the special nature of the storage of items, there is a higher demand for the storage location, hardware facilities and the quality of employees. The most important thing in the process of storage and management of hazardous chemicals is safety, which is an important manifestation of its difference from other ordinary storage. If classified by the nature of use and size, hazardous chemical warehouse is divided into the following three categories: professional warehousing or field warehousing of large-scale businesses, foreign trade, materials and transportation departments; production affiliated warehouses of medium-sized factories, mines and enterprises; small and general-purpose warehouses. The management arrangements are shown in Figure 1.

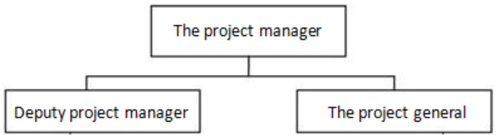

Figure 1: Staffing

Quantitative risk analysis is a method of systematically analyzing the frequency and consequences of an activity or project. In this way, the risk in activities or projects can be quantified. Quantitative risk assessment is a comprehensive application of failure modes and impact analysis, event tree analysis, fault tree analysis and probability tree analysis. It is a complex, comprehensive and widely applied risk assessment method. The quantitative analysis of risks of hazardous chemical storage is mainly to compare the degree of impact of the factors affecting storage safety on the final target, in order to determine the weight of these factors in the target and to compare the factors affecting the target with each other to obtain a judgment matrix. The probability of storage accidents of hazardous chemicals and the consequences of accidents thereof may be very different. It is necessary to comprehensively calculate the risk factors that affect the process of warehouse management to obtain the total risk value of the entire process. The formula for testing the comparison judgment matrix consistency is:

$$CR = \frac{CI}{RI}$$

The specific model is shown in Figure 2.

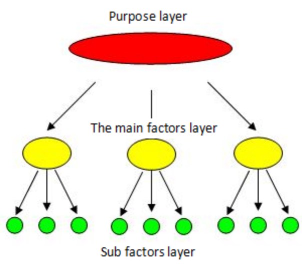

Figure 2: Quantitative analysis

$$CR = \frac{CI}{RI}$$

3. 2 System functions

The information-based level of hazardous chemicals storage enterprises is low, and a lot of processes are operated manually. This is not only inefficient, it wastes human resources and the possibility of accidents caused by manual operation error is very great. In order to improve the efficiency of hazardous chemical storage management and ensure the safety of hazardous chemical storage and transportation, we urgently need to establish a safety assessment system for hazardous chemical storage.

According to the above analysis of hazardous chemical warehouse management system, we can conclude that the functional modules of the warehouse management system we need to establish include: enterprise personnel information management module, hazardous chemical warehouse management module, system management module and statement management module. The personnel management includes the management of enterprise personnel information and the modification of user information. The warehouse management module includes the storage management, delivery management and inventory management of hazardous chemicals. The system management module is mainly responsible for the management of user information, goods information and database management. In the statement management module, we can perform information query of warehouse staff, hazardous chemical goods and storage location, management of out-put and in-put of receipts and management of printer job logs for some inquiries. The assessment information management module is mainly about the assessment of storage safety, as shown in Figure 3 below.

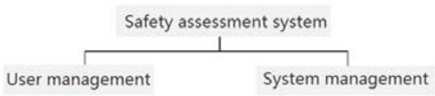

Figure 3: System functional framework

3. 3 Module design

The specific processes of module design are shown in Figure 4 below.

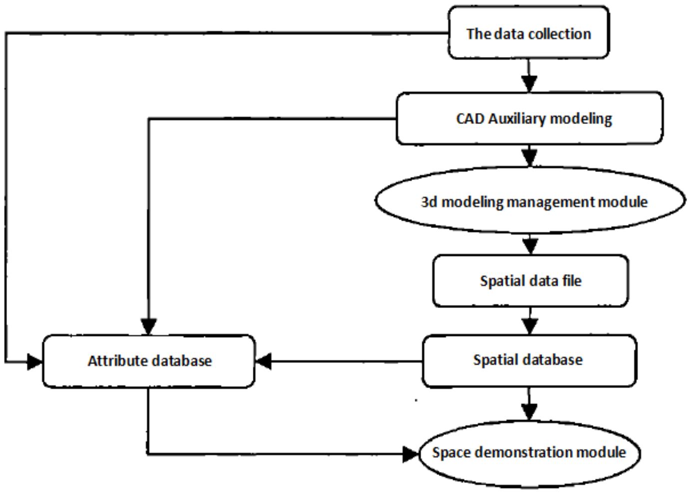

Figure 4: Modular structure diagram

This study is based on virtual integrated computer-assisted design (VCAD). Due to the uncertainty of the plan in the design phase of project, the construction schedule and the arrangement of the power station, the shape of the section, etc., need to be continuously adjusted. In order to make the change of the engineering design plan reflected in the 3D construction simulation in time and the construction simulation can accurately provide the visual information for designers and achieve the purpose of assisting the design, there must be corresponding considerations both in database design and the demonstration method of project. For the entry of engineering construction network plan data, manual input should be reduced as much as possible so that the data input can be automated and at the same time, the modification of the plan can be facilitated. The data entry part of the demo module can easily read the file types generated by the construction plan software, and save them to the database and design an interface for modifying the construction plan in the database, which can easily modify the construction plan data imported into the database. The modification of the construction

network plan should ultimately be reflected in the 3D presentation. Therefore, the storage of spatial data and the corresponding way of spatial data and construction network planning data should make the modification of the plan easily reflected in the demonstration process and reduce the time needed for the demo model modification due to plan modification.
After obtaining spatial data and construction network planning data, how to effectively organize them together is a key issue for the demonstration of construction plans. This can be done in accordance with actual conditions. In actual work, the pouring of dams is sequential and most of them are from top to bottom. In the process of generating spatial data, the entire dam has been divided into many parts, so as long as the corresponding components are calculated from the construction intensity requirements of the construction plan, the same time values are assigned to the components in the same construction period, that is, the current construction date, it can determine the construction completion within this time frame. However, this method is also defective. Since the stratification is not carried out under the premise of the construction plan, there may be a stratification across two construction time periods. At this time, the stratification is not divided into two but one construction period due to the different algorithms, which resulted in errors between the construction demonstration and the planning data. This error cannot be eliminated. In order to reduce the error, the height of the stratification can be adjusted to be very small, such as 0.2 m, so that the error is controlled within 0.2 m. The selection of this value depends on the accuracy requirements of the demonstration. However, if the value is too small, the amount of data will increase and the calculation and modification process will increase accordingly. While calculating the construction time, the location of the layer for spatial data should be specified to facilitate future demonstration needs.

4. Results and discussion

The system function module design results are shown in Figure 5 below.

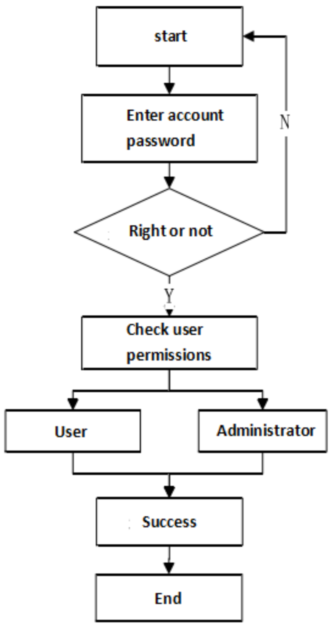

Figure 5: Login flow chart

The enterprise management safety assessment module is mainly designed for enterprise management assessment. Its main function is to determine the selection of enterprise assessment factors in the assessment factor system and the calculation of its weight value. Through this module, experts can assess the level of enterprise safety management and the assessment results are stored in the local database. The assessment factor management module is for system administrators. It is mainly used to manage various key assessment factors obtained during the operation of enterprise, which are stored in a local database for the storage risk calculation of hazardous chemicals. According to the scores given by assessment personnel, the weight values of the safety assessment factors of hazardous chemical storage enterprise can be determined and the system records the weight values of the assessment factors to facilitate the calculation of the risk of hazardous chemical storage. The assessment personnel can use this module to score the management status of hazardous chemical storage enterprise, as shown in Table 1 below.

Table 1: Enterprise management scoring interface

An enterprise name	Points
Employees factors	
Information factors	
The vehicles	
Warehouse facilities factor	
Practices	

The system will calculate the relevant results of enterprise management assessment based on the scores and the method of determining the enterprise management factor and record it in the enterprise information. For this industry with a long construction period, many participating units, long distances of various units, complicated processes, various kinds of materials and large quantities, modern information technology can provide it with a relatively satisfactory dynamic information exchange management platform.

5. Conclusions

In this paper, the author introduces some existing hazardous chemicals, provides a theoretical basis for the study in this paper, combines the research and comparison of the evaluation model, discusses the influencing factors of construction project management and builds a risk assessment model. Judging from the present situation, using the software engineering idea to design different models in the system construction, we can start with the perspectives of user information management, construction process management and system management, and realize the design and mastery of each module according to the subject framework required by the system, and integrate the safety assessment model into the management system. In addition, the data needed in the construction process are calculated by means of assessment, which provides an important reference for project management. However, due to the particularity of hazardous chemicals, chemical properties should also be taken into account in the project management. Therefore, the evaluation model system needs to be further optimized and improved. Based on different calculation results, it can be used to determine whether it can be used universally and the current defects in research can be remedied.

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