Software Design on Technique Decision-making for Capital Repair of Overhead Crane

Shan CHEN*, Jun-chun MA, Bao-min QIANG, Liang LI and Zhen-xin HE
Research Inst. of High-tech Hongqing Town, Xi’an, Shanxi, China
*Corresponding author

Keywords: Overhead crane, Capital repair, Software, Technique decision-making, Database.

Abstract. In order to facilitate the parameters inputting and arranging of overhead crane to obtain capital repair project and provide capital repair decision-making, the software system on technique decision-making for capital repair based on VC+ACCESS was developed. Firstly, the information of overhead crane was classified into basic information, maintaining information and inspecting information. Secondly, information datas were input respectively based on the three aspects. Thirdly, according to the input information, the preliminary capital repair plan was given. Lastly, according to the information and the plan, the capital repair forecast cost was given. The software solved the informationization problem of lifting equipment capital repair datas.

Introduction
Overhead crane is one of the most common equipments in the workshop and factory. It is an important means to improve the safety of the equipment by inspecting and maintaining termly. At present, it is hard to maintain the equipment and manage the fund for the complicated maintenance procedures of crane and uncertain capital repair cost and timing [1-2]. Therefore, it is particularly important to realize computer-aided decision-making and scientific management of crane capital repair[3-4].

This paper started from capital repair of crane, established database, proposed the capital repair technique decision-making algorithm based on the practical experience, gave the capital repair plan, developed capital repair technique decision-making software and provided capital repair decision.

Software Functional Requirements Analysis
This software mainly completed inputting and saving all information of the overhead crane before and after capital repair. It also gave the basic capital repair plan according to the condition of crane for the inspectors. Therefore, the main function modules of this software included system, information management, process management, documentation, user management and help.

System module mainly realized the function of login, logout and exit of user. According to the different permissions, there were two types of users, of which one was administrator, who could enter information, information maintenance, personnel maintenance and all other operations, the other was customer, as inspector, who only could enter information, inquiry information.

Information management module mainly realized the function of constructing, modifying, deleting and inquiring the basic parameter information, maintaining information and inspecting information of the overhead crane. According to the inputting information, it was easier to give the cost budget and decision-making of capital repair.

Process management module mainly realized the function of setting the plan and process flow of capital repair according to the information of overhead crane inputting information, computing and forecasting capital repair cost, recording information about inspecting, testing, checking and accepting after capital repair.
**Basic Principle of Software Design**

The software adopted modular design idea, in which each module was independent and had the same interface protocol for secondary development and the similar design ideas [5]. The overall design of software was shown as Figure.1.

![Figure 1. Overall design scheme of software.](image)

**Information Management Module**

Information management module mainly completed inputting information for new equipment and modifying information for existing equipment. When inputting information, the progressive relationship and correctness of information inputting must be considered, also as the simplified inputting method for batch data. Software design principles was shown as Figure.2.

![Figure 2. Design Principles of Information Management Module.](image)
Process Management Module

Process management module mainly generated capital repair plan and calculated capital repair cost according to the equipment information, also input relevant information of checking and accepting after capital repair. Process management module was divided into capital repair plan sub module, capital repair cost calculating sub module and checking and accepting sub module.

In the capital repair plan sub module, there were several steps. Firstly, capital repair projects were set up. Secondly, according to maintenance information and inspecting information, the capital repair content of every project were produced. There were different contents in different projects because of different maintenance and inspecting information. In order to distinguish the content, it was produced with template way in software, so that user could modify the contents on this basis.

Capital repair cost calculating sub module could calculate the cost automatically according to the information filled in before, with the calculation formula as follows.

\[ F_{DX} = (1 + \lambda) \times (F_{DZ} + F_{JJ} + F_{GZ} + F_{RG}) / (1 - K_G) \]

In the formula,
- \( F_{DX} \) - Capital repair cost for each equipment,
- \( F_{DZ} \) - Capital repair cost for electronic components materials of each equipment,
- \( F_{JJ} \) - Capital repair cost for mechanical components materials of each equipment,
- \( F_{GZ} \) - Capital repair cost for reconstructing of each equipment,
- \( F_{RG} \) - Capital repair cost for work, fuel and power of each equipment,
- \( K_G \) - Adjustment factor of capital repair management cost for each equipment,
- \( \lambda \) – Profits of Capital repair for each equipment.

\( F_{DZ} \) was calculated from the data of maintenance information. \( F_{JJ} \) was calculated from the data of inspecting information. \( F_{RG} \) was calculated from the data of capital repair plan combining with working hour fee presetting. The three items couldn’t be changed. \( F_{GZ} \), \( K_G \), \( \lambda \) were presented by users, also could be changed according to actual situation.

Software Design Result and Application

According to the design scheme and design algorithm above, system software design was completed with VC + ACCESS. The main interface and menu of software were shown as Figure.3 and Figure.4. The main function modules of system main menu included system, information management, process management, documentation, user management and help.

Figure 3. Design Software system main interface.
The information management module mainly realized the new, modifying, deleting and inquiring function of basic parameter information, maintenance information and inspecting information of the overhead crane. Capital repair cost would be given by the inputting data, so capital repair decision-making could be made better, which were shown as Figure.5 – Figure.7.

The process management module mainly realized the setting of capital repair plan and process flow, calculating capital repair cost, recording relevant information of checking and accepting after capital repair, according to the overhead crane information inputting in the information management module. It included three function modules which were capital repair plan, capital repair cost calculating, checking and accepting after capital repair.
The document module mainly realized the editing and printing documents of capital repair conclusions, capital repair reports, checking and accepting reports, maintenance application form, etc.. The user management module mainly realized the maintenance of all kinds of data, such as user data, crane data, inspecting data, etc..

Summary
This paper analyzed the function requirements of overhead crane capital repair decision-making, established corresponding database according to the function module, completed the software of capital repair technique decision-making with VC+ACCESS and gave the software interfaces. The software had already been applied in the analysis of decision before overhead crane capital repair, through which that was more scientific to manage the performance and condition of crane and more accurate to give the budget of capital repair timing and cost. The development of this software provided an important basic for technique decision-making for the inspecting and maintenance of overhead crane.

References