Design and Implementation of a Power Fixed Asset Management System Based on JBPM Workflow

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Abstract. Workflow technology is the core technology that enables enterprise business process modeling, simulation analysis, optimization, and business process management and integration, ultimately achieving business process automation. Studying and promoting workflow technology has important practical significance for enterprise informatization. With the globalization of market competition, enterprises must be able to quickly restructure their business processes to improve their competitiveness, which has led to widespread attention and research on their workflow issues. However, the current workflow technology is still not mature enough, especially when business processes involve collaboration between different enterprises, there are many deficiencies in interoperability. The emergence and development of web services have effectively solved this problem, so JBPM workflow technology based on web services has made up for the shortcomings of current workflow technology and has become a development trend. Through a specific description of the current situation of fixed asset management in the power industry, a demand analysis of the power fixed asset management system was carried out, and the overall design of the system was carried out. The standard J2EE three-layer software architecture system was adopted, with a component-based and object-oriented development mode as the overall design and development principle. Targeting the characteristics of wide scope, multiple departments, large quantity, large amount, and fast update of fixed asset management in the power industry, Strive for comprehensive and detailed functionality, easy and simple operation, and emphasize network information exchange and sharing. Finally, using the MVC pattern for detailed design and combining Struts, Hibernate, and other frameworks with the JBPM framework for specific implementation development, ultimately achieving the comprehensive goal of strengthening management, reducing labor intensity, reducing office costs, and improving office efficiency.

Keywords: Workflow management system, JBPM, web services, fixed asset management

1 Introduction

As an emerging enterprise information technology in the 1990s, workflow management technology has been widely applied in the field of business process management. Workflow Management System (WfMS), as an important and emerging branch of Computer Supported Collaborative Work (CSCW), has broad application prospects[1-3]. However, with the popularization of computers, especially PCs, and the extension of computer networks, the

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information resources shared by modern enterprises are increasingly exhibiting characteristics of heterogeneity, distribution, loose coupling, and timely response. Moreover, complex business processes within and between enterprises are increasingly being applied to practical production and daily life. This development direction makes some traditional, local application oriented workflow technologies urgently need new breakthroughs to adapt to the development of new technologies and changes in the actual needs of enterprises[4-7].

In recent years, the main research content in the field of workflow theory and implementation technology includes: (1) research on the architecture of workflow management systems; (2) Research on workflow models and workflow definition languages; (3) The transaction characteristics of workflow: Research how to combine advanced transaction processing technology with workflow management technology, improve the correctness and reliability of workflow systems with well-defined model semantics and recovery mechanisms, and thus better support complex business processes of enterprises; (4) Workflow implementation technology: various technologies and methods related to the design of workflow systems, including object-oriented technology, heterogeneous distributed computing technology, graphical user interface, message communication, database, WWW, etc; (5) Simulation and analysis methods for workflow; (6) Application integration and interoperability technology based on workflow: studying the integration of heterogeneous application systems and the interoperability issues between different workflow systems; (7) Workflow and Business Process Reengineering (BPR); Research how to support enterprises to quickly and efficiently achieve business process restructuring through the implementation of workflow systems; (8) How to apply workflow technology in different fields, including CIMS, in other applications of workflow technology research[7-9].

In recent years, workflow has developed rapidly in China, with many companies, research institutions, open-source organizations, and individuals engaged in the research and development of workflows[10-13]. Some workflow products abroad include BEA's WLI, Fujitsu's i-Flow, IBM's Holosofx, SAP's NetWeaver, Sonic's Orchestration Server, Ultimus, and Versata. Domestic companies and products that focus more on workflow include Xi'an Collaborative Digital SynchroFlow; LiveFlow of Shanghai Donglan; SunFlow and others from Hangzhou Xinyada. However, overall, domestic workflow products are still in their infancy, and their reliability, stability, openness, and standardization still need to be strengthened. In short, there are too few products available that meet the actual needs of Chinese enterprises and follow standardization.

2 Workflow management technology

Workflow technology, supported by information technology, provides a complete framework for enterprise business processes from model analysis, establishment, management, simulation to operation. It is a key technology for achieving business process management and control. The emergence and rapid development of workflow technology provide important technical support for the implementation of advanced manufacturing strategies in enterprises.

2.1 Concepts related to workflow

Workflow: Workflow is an abstraction of business processes for specific applications. It is the overall or partial automation of business processes, where documents, information, or tasks are automatically passed from one participant to another for processing according to a set of rules.

Workflow Engine: A workflow engine provides an execution environment for a workflow instance. Its services include: interpretation of process models, control of process instances (creation, activation, pause, termination, etc.), traversal between process activities (calculation of control conditions and data transfer, etc.), joining and exiting participants, generating work item notifications for users to process, maintenance of workflow control data and workflow related data, calling external applications and accessing workflow related data, etc.

Workflow management system: A system that runs on one or more workflow engines and uses software to define, create, and manage workflow execution processes. It can translate process definitions, interact with workflow participants, and call IT tools and application software when needed.

Workflow model: A workflow model is an abstract representation of a workflow, that is, an abstract representation of a business process. A workflow model is the result obtained by formally describing the business process of a certain application domain using a workflow definition language, which contains the information required for workflow execution.

Activities: Activities are work tasks in logical steps or stages of a workflow, generally divided into manual operations and automatic processing. An activity is the smallest unit of work in process execution, requiring the participation of personnel or automatic completion by a computer.

Process instance: A process instance is a business process that is actually running. Each instance represents a thread that can independently control execution and has an internal state. In the business process executed by process instances, WFMS will interpret the corresponding process definitions, produce relevant activity instances, and coordinate the sequential relationships between these activities according to the control rules in the definitions. At the same time, data transfer between activities is completed based on the definition of data flow relationships. From the perspective of participants, the execution of an instance is actually the process by which the participant processes the data of the stage they are involved, completes the tasks of that stage, and then WFMS activates subsequent stages based on the corresponding results, while notifying subsequent participants to process them. This process is repeated in sequence until the entire process is completed.

Task: Unified representation of activities and work items, representing activities in the context of workflow definitions and work items in the context of workflow instances.

Routing: The relationship between tasks in a workflow instance, with basic routing relationships including Sequence, Choice, Fork, Merge, Synchronization, etc.

Organization: What is required for task execution, generally refers to participants, which can be machines or humans.

The workflow diagram is shown in figure 1.

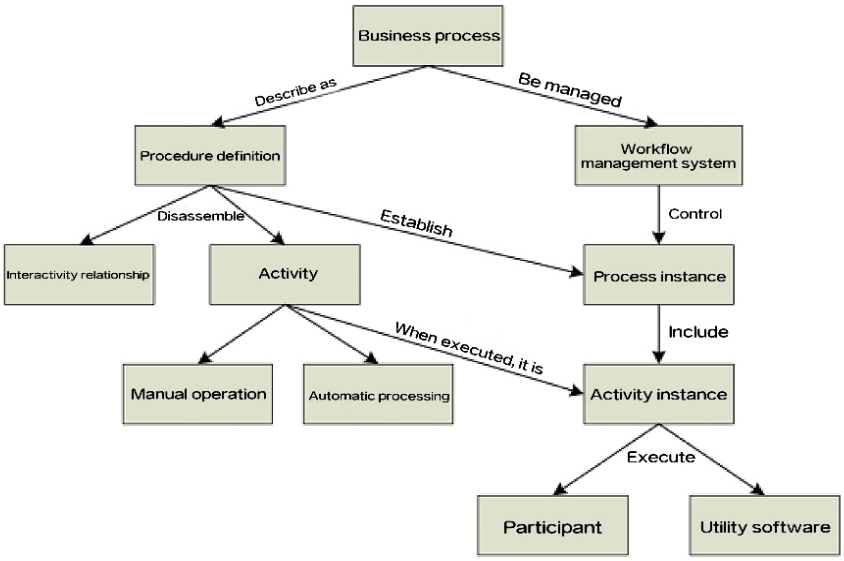

Fig. 1. Concept diagram of workflow.

Some calculation formulas used by power companies in fixed asset management. These formulas can help power companies better manage their fixed assets, improve asset utilization efficiency, and reduce maintenance costs. The following are some commonly used fixed asset management formulas for power companies:

$$X^* * (1 - Y^*)/Z^* = R^* \tag{1}$$

Formula 1 is the fixed asset depreciation formula, where X^* is the original value of the fixed asset, Y^* is the estimated net residual value rate.

$$X^* - L - T = V \tag{2}$$

Formula 2 is the fixed asset net value formula, where L is cumulative depreciation, T is impairment provision, and V is the fixed asset net value.

$$R^*/A^* * 100\% = S \tag{3}$$

Formula 3: Fixed asset utilization rate formula, where R^* is the actual usage area, A^* is the total area, and S is the fixed asset utilization rate.

$$W^*/(A + 1) = S^* \tag{4}$$

Formula 4 is the fixed asset maintenance cost formula, where W^* is the total maintenance cost, A is the number of repairs, and S^* is the cost of each repair.

2.2 MVC Pattern

The MVC pattern consists of three types of components. The Model component is used to describe the data in the application, independent of the user interface; The View component is responsible for presenting data to users; The Controller component translates user operations

into operations on the Model component; After receiving the operation from the Controller, the Model updates the View to reflect the changes in data. The responsibilities of these three types of components and their relationships are shown in figure 2.

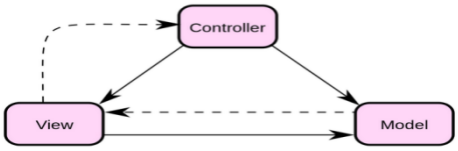

Fig. 2. MVC model diagram.

The solid line in figure 2 represents method calls, and the dashed line represents events. The advantage of MVC is that it separates the development of the display layer and the business logic layer, separating the work of graphic designers and programmers, which is beneficial for the development of large-scale systems. Secondly, having the control layer control the entire process can reduce the need to write complex conditional judgment logic and program code for process management and control in the components responsible for display. Once again, the separation of the display layer and the pattern layer ensures that modifications to the pattern layer do not affect the display layer, making the program easy to maintain. Therefore, using the MVC development pattern can improve the reusability and maintainability of components.

3 Model design implementation

This system adopts a top-down, step-by-step refinement method to decompose the system into relatively independent and single functional modules. The application architecture of the fixed asset management system is shown in figure 3:

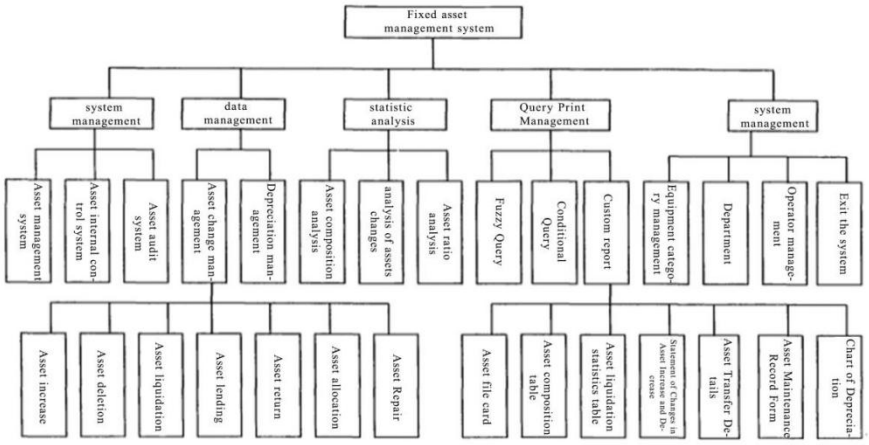

Fig. 3. Overall structure diagram.

3.1 Fixed asset management module

The fixed asset management module includes: fixed asset increase module, fixed asset decrease module, asset management module, engineering management module, report management module, comprehensive query module, and key indicator module. This will be explained separately here.

Fixed asset enhancement module: This module implements the approval process and card creation management business for new fixed assets from different sources. According to the different sources of assets, they are divided into: new construction fixed assets, zero purchase fixed assets, allocated fixed assets, and inventory surplus fixed assets. Different sources of fixed assets require different fixed asset enhancement processes and related business operations.

New project reinforcement: Implement the input and approval management functions for new project reinforcement.

The engineering management specialist submits the asset delivery list associated with the project after the project settlement. Users enter physical information, financial information, ancillary equipment, and other information of assets in different processes, and finally establish fixed asset cards through the new project to fixed asset conversion process.

3.2 Database system design

A database system is a repository for managing and storing information. At present, the mainstream database vendors and products in the market are related to IBM DB2, MS SQL Server 2000, ORACLE 9i, Sybase, etc. They each have their own characteristics and advantages, and have played a huge role in different application fields. DB2 is a product of IBM, originating from SystemR and SystemR *, supporting platforms from PC to Unix, from small to large machines, and from IBM to non IBM products; Sybase is a high-performance and highly reliable relational database management system for online transaction processing.

Due to the wide variety and large amount of data involved in this system, we used multiple tables to differentiate data with different functions when designing the database system. The design of the database is shown in table 1.

Table 1. Asset Category Table.

Entity Name	Entity Description	Entity attributes
Unit information	Record detailed information	Contact person, email, address, phone number
Personal information	Record basic information	User ID, username, user ID
Role	Record character information	Role ID, User ID, Number
Authority	Record functional information	ID number, function name, affiliation

3.3 Experiment

To verify the performance of the system, experiments were conducted to obtain the asset utilization rates of each subordinate institution by drilling through institutions on the total asset utilization rate, as shown in the following figure 4:

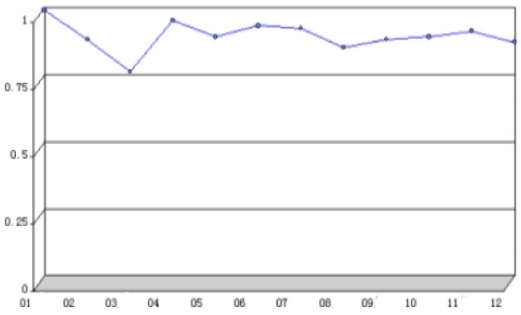

Fig. 4. Monthly Asset Ratio Curve.

The performance indicators for measuring a workflow management system include whether the workflow model can meet performance requirements, throughput, average turnaround time, resource utilization, and so on. Performance testing was conducted on the system using LoadRunner 7.6.0.5, and the results are shown in the following figure 5:

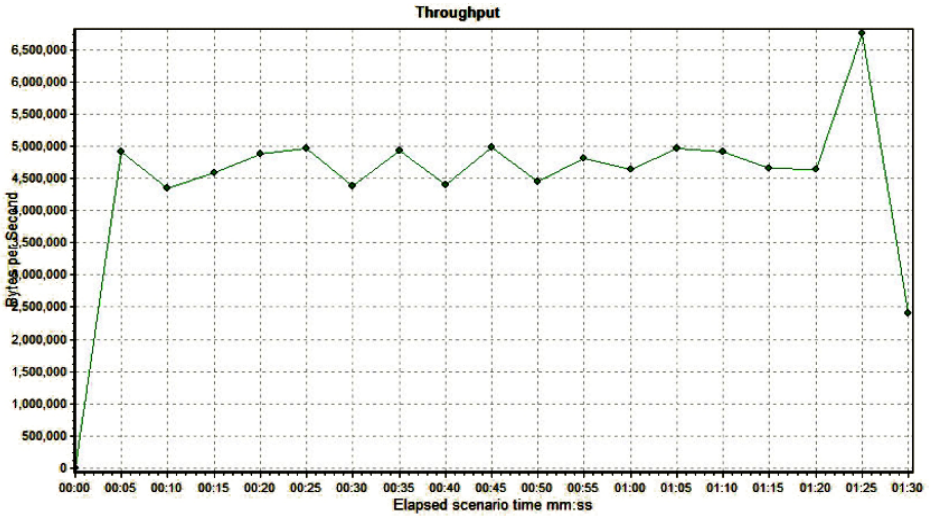

Fig. 5. Performance test result chart.

According to the analysis report of LoadRunner's test results, the test took 1 minute and 33 seconds, with a total throughput of 420422056 bytes and an average throughput of 4472575 bytes per second. The average response time of the system is 0.254 seconds.

4 Conclusion

After studying and researching existing workflow technologies, especially the latest JBPM, a workflow system based on JBPM has been proposed and implemented. And applied examples and tested the workflow system. In the management of increasing and reducing fixed assets,

the characteristics of the processes in the power industry were first analyzed, and models for increasing and reducing fixed assets were designed. Finally, the MVC mode and Struts, Hibernate and other frameworks were combined with the JBPM workflow framework for specific implementation.

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