

Design and Development of Material Management System for Power Enterprise Group

Gang Xiong^{2,1}, Jiachen Hou^{1,2}, Dong Fan^{2,1}

¹State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, Beijing, 100190
Email: gang.xiong@ia.ac.cn

Xisong Dong^{1,2}, Yanjie Yao¹, Xiuqin Shang¹

²Dongguan Research Institute of CASIA, Cloud Computing Center, Chinese Academy of Sciences, Songshan Lake, Dongguan, 523808, CHINA

Abstract - With the fast development of the market economy in China, the material management of the Power Enterprise Group has changed and met many challenges. On the other hand, with the fast increase of Internet and data scale, some problems of enterprise material management can be solved by using IT technologies, such as database. For examples, it can help enterprises to develop the suitable management systems, so as to improve the management level and the enterprise's competitiveness. In the paper, compared with the traditional material flow management, a new flow model management was proposed for the complex management system of Power Enterprise Group, and material management system are designed and developed to realize the unified management on three tiers, i.e. Headquarter, Distribution management centers and Local power plants.

Index Terms - Material management system; Procedure management; Procedure modeling; Power enterprise group

I. INTRODUCTION

Normally, power enterprises group is composed of many units in three tiers, i.e. Group head quarter, Distribution management centers and Local power plants. For a long time, most power enterprises in China execute their material management with very simple and traditional way, each department of each unit can purchase its material separately, which means any kinds of material can be purchased anytime from any vendor at any price and quantity, by anybody according to their own requirements and specification, which causes many problems such as repeated and wasteful purchasing which leads to overstocking, material quality and cost controlling becomes difficult etc. In fact, material management became research topic in 1980's [1].

With the fast development of the market economy in China, the material managements of, construction enterprises [2-3], nuclear power plant [4], power enterprises have changed dramatically, and many problems and challenges must be overcome. On the

other hand, with the fast development of Internet and data scale increase, some problems of enterprise material management can be solved by using IT technologies, such as database. For examples, it can help enterprises to develop the suitable management systems, so as to improve the management level and the enterprise's market competitiveness [5-8]. Artificial systems can be developed to improve the safety and reliability of nuclear power plant [9], normal power plant [10]. Complex network can be applied for the vulnerability identification in Smart Grid [11]. The latest cloud computing is introduced to enhance power distribution network management [12].

In the paper, compared with the traditional material flow management, new flow model management was proposed for the complex management system of Power Enterprise Group, and material management system is designed and developed to realize the unified material management on three tiers (Fig.1.).

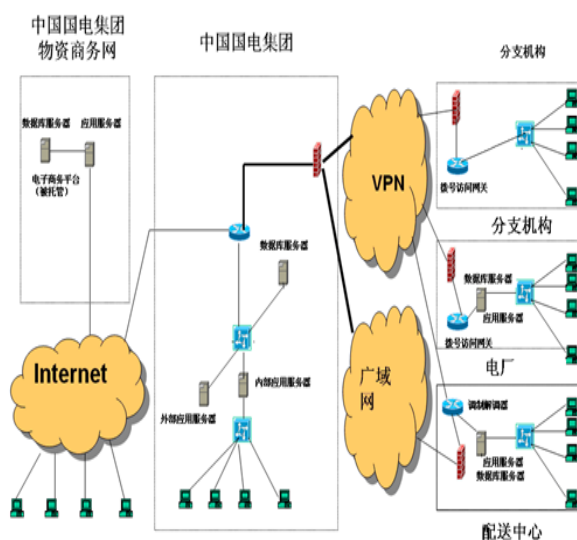


Fig.1. the unified material management

China GuoDian Corporation is the case study customer

of the paper. The unified material management system can share accurate and real-time information all over the Corporation, strengthen and improve the material management to fulfill the challenge demands: "Unified management, centralized purchasing, regional distribution."

A good procedure management is the necessary pre-condition for realizing the unified material management of one enterprise group. A flexible procedure management system can make the procedure design work easier for all kinds of procedures, which becomes the common communication mechanisms among different projects, different departments, different systems, and different units. The various procedures of the enterprise group should be adjusted continuously and improved for its optimization according to the various changing demands. So, the procedure management is not only a simple procedure structure changing, but also a complicated structure adjustment. To build the Material Management System for the unified management of Power Enterprise Group, flexible procedure management is necessary for the effective and orderly management and flexible management. In this paper, by compared with the traditional material procedure management, new procedure modeling was designed for the complex management system of Power Enterprise Group.

This paper is organized as follows: the new procedure management is analyzed and designed in Section II. After solving the procedure modeling problem and the new material management system are designed in Section III. The development and pilot of the new material management system is described in Section IV. Finally, conclusions are drawn out, and future works are summarized in Section V.

II. PROCEDURE MANAGEMENT

Different management procedures come with the building up of any new corporation, and become more and more complex with the development and growth of those corporations. Each corporation and its sub-organizations have their own and specific procedures for different businesses and services, which is made up of various complex sub-procedures. So, those procedures and sub-procedures should be managed reasonably in order to realize the unified management on corporation level. Flexible business process can be realized by suitably connecting different procedures, so efficient procedures

management can make many benefits, such as: Time and cost saving; Efficiency and quality improvement; Clear accountability and no duplication etc.

Besides saving time and cost, efficient procedures management also help corporations to drastically reduce or even eliminate the faults or damages of corporations, which are normally caused by document lost, or important information missing, and necessary review process ignoring. On the other hand, a clear procedure helps every employer and employee to know the general status of all involved projects and tasks, and the accurate detail and status of his or her duty. And, the manager exactly knows all the information of the project and the duty detail of every participant.

Efficient procedure management is the necessary pre-condition for the unified management. The complex and flexible procedures is required to realize the unified material management system for power enterprises group.

If the procedure management can't be operated effectively, the business process can't track the implementation detail of the management operations, and this would seriously affect the unified management of the entire system.

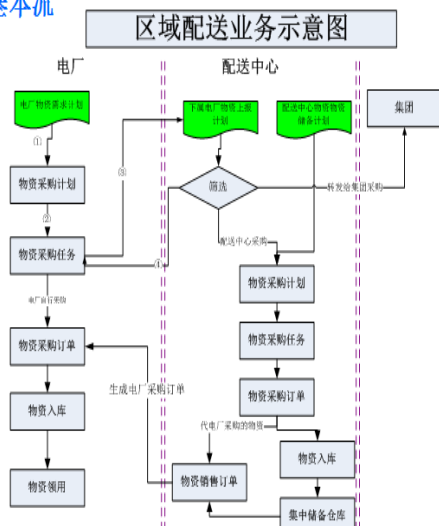
The most of traditional procedure managements can't allow small adjustments; the adjustment of their procedure structures becomes almost impossible. For example, the procedure structure of material warehousing, storage and release is simple procedure structure, which includes: material purchase, material warehousing, material back process warehousing, finished product warehousing, material release, product release, after-sales release, etc. Small adjustments of the procedure structure can only made in a given mode by specific users, no adjustment can be made in the traditional procedure management. Because of its inflexibility, the traditional procedure managements couldn't meet the unified management demand of material management system for power enterprises group.

III. PROCEDURE MODELING

The material management system for power enterprises group asks for the more complex and flexible procedures (Fig.2), which should be re-designed reasonably. The existing procedure structures should be made a lot of adjustments or re-structuring in order to meet the demand of the unified material management. Not just copying the given procedure structures, the procedure management should be re-designed, the sub-procedures should be

re-structured by using of the latest information technology, so the complex and flexible procedures can be configured out easily.

采购入库基本流程



结算流程

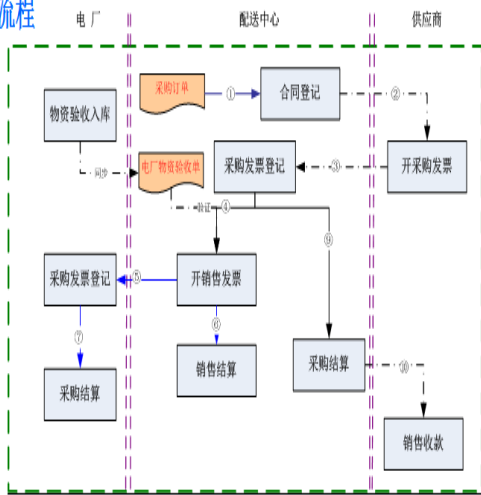


Fig.2. The complex and flexible procedures

With the new complex and flexible procedures, the material management system of power enterprises group becomes more flexible. A new procedure of material management can be configured out easily and does not destroy the given procedures structure.

By analyzing the existing procedures, we summarized that every procedure structure consists of processes and some events. For example, the procedure structure of material warehousing. According to this thought, the complex procedure can be split into points and directions. Point means event, while direction means process. The start point and the ending point are the two special points of the procedure, which are the only kind of points to show the start and ending of the procedure. Direction shows the process information of the procedure. By using the points

and directions, users can design their own flexible procedure which can be used in the any complex situations. Users don't need to destroy the given or old procedure structures for the new procedure creation.

In the daily operation of material management, end users could create the complex procedure structure by using points and directions existing in the procedure modeling. Points can be set for different departments, positions or users by procedure modeling. In this way, the complex and flexible procedure managed by the procedure modeling can deal with the unified material management system for power enterprises group. It helps the end users to create the complex procedure structure of the unified material management system, which fit the real situation.

With the complex and flexible procedure, there's no need to buy new software just for the new procedure creation, which can't be created by changing the given procedure structure. Thus, it becomes the necessary part for the unified material managements system of power enterprises group.

The material procedure management is mainly composed of four parts: procedure modeling, procedure query, procedure management, task management. The structure diagram of the material procedure management system designed as Fig.3.

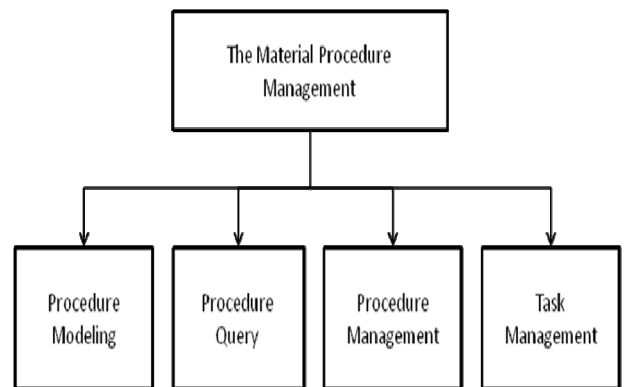


Fig. 3. The structure diagram of procedure management system

Procedure modeling is the kernel of the material procedure management. It is used to select and modify an old procedure structure, and create a new procedure structure. At the same time it is used to set the properties of the procedure points and the properties of the procedure directions.

Procedure query is used to retrieve the information which is related to the procedure like the state of the running instance, the processing time and the employees. With the help of the procedure query, users can check the

state information and analysis the information of the procedure.

Procedure management is the important part of the whole system, it helped the users to edit and manage the procedures, for example, the suspending of the procedures, the deleting of the procedures and the procedure data recovery.

Task management offers those services like task viewing, task linking and task refreshing etc. Users can operate the system and improve efficiency with the help of Task management.

The four parts: procedure modeling, procedure query, procedure management, task management, the procedure management help the ordinary workers to design the procedure structures, which can be designed only by professional programmers or experts without the procedure modeling. So, the procedure management becomes much easier and more flexible than before. The procedure modeling of the material management system could deal with more complex and flexible procedures, and the unified material management system could be realized for China GuoDian Corporation.

IV. MATERAIL MANAGEMENT SYSTEM

The material management system is developed for China GuoDian Corporation, our case study customer, by using the J2EE application server technology and B/S architecture with three tiers; the procedure management part of the system also chooses the J2EE application server technology and B/S architecture with three tiers to make the program compatibility well. Back-end database of the system is ORACLE Oracle9i Server. And it was designed and developed with component program idea in order to provide the extensibility of the system. It has standard and uniform interface.

A. Feasibility Analysis

Under the practical circumstances, there are lots of objective conditions and requirements for the application of the procedure management [8].

1) The stable network access environment: The current internet network has become popular. There is no hardware problem for the network. It provides the objective condition for information sharing and the unified management through the internet.

2) The maturity and development of the modern information technology: The technology to develop

material management system becomes mature, and the project have little technical problem.

3) High awareness levels of infomationization: The awareness levels of infomationization in China GuoDian Corporation are relatively high. In recent years, China GuoDian Corporation has become aware of the high effectiveness of infomationization, leading to the construction and application of infomationization systems [9]. And material management system has become the necessity to meet the demands "Unified management, centralized purchasing, regional distribution". By making full use of the information system, business operation efficiency can be improved, and the management costs and waste can also be controlled or even reduced at the same time.

B. Application

With the help of the visual interface of the material management system, users can easily view and analyze the overall statistic statement of China GuoDian Corporation or any specific information easily, then correspond management can be executed easily, and its improvement can found and executed continuously.



Fig.4. User interface of the unified material management

For example, stock information can be got easily and shown visually by using the stock analysis function of the material management system (Fig.4), such as the stock information of the chemical depot, the information of the instrument depot, the information of the electromechanical depot and the information of the metallurgical depot. All those functions provided by the system significantly help China GuoDian Corporation to realize the unified material

management on three tiers.

C. Procedure Management

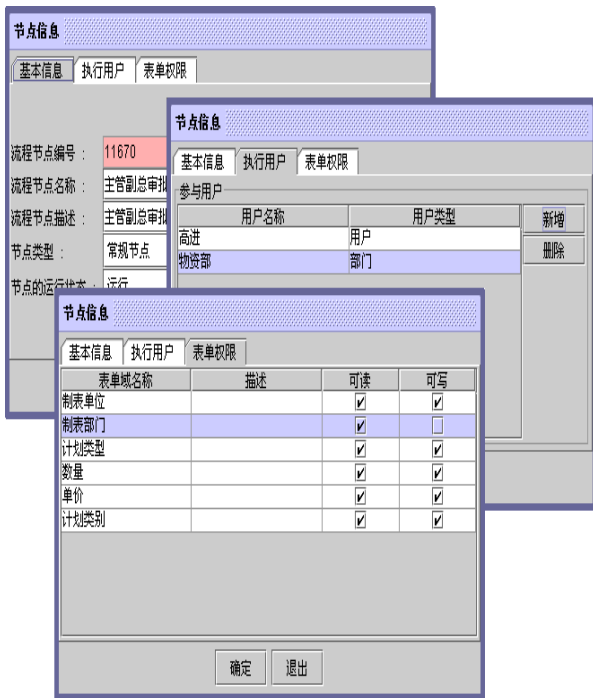


Fig.5. Points setting for the new procedure



Fig.6. New procedure setting of the unified material management

By using the procedure management of the material management system, the better procedure structure of purchase order function can be built up for China GuoDian Corporation. The procedure structure of purchase order can be created by simply setting of points and directions (Fig.5), and accessing the table. By using the procedure management function, users can design their own flexible procedure (Fig.6) which can be used in the complex

situations. Users don't need to change the given procedure or the old procedure structures for creating the new procedure. The procedure management system (Fig.7) could adapt easily to the complex and flexible material management situation in China GuoDian Corporation.

By using the procedure query, users can check the graphical procedure structure and the historical data. Meanwhile, the procedure structure (Fig.8) can also be queried by using name, table, time, status, and the combination of these criteria options, in order to provide the facilities for the unified material management [12].

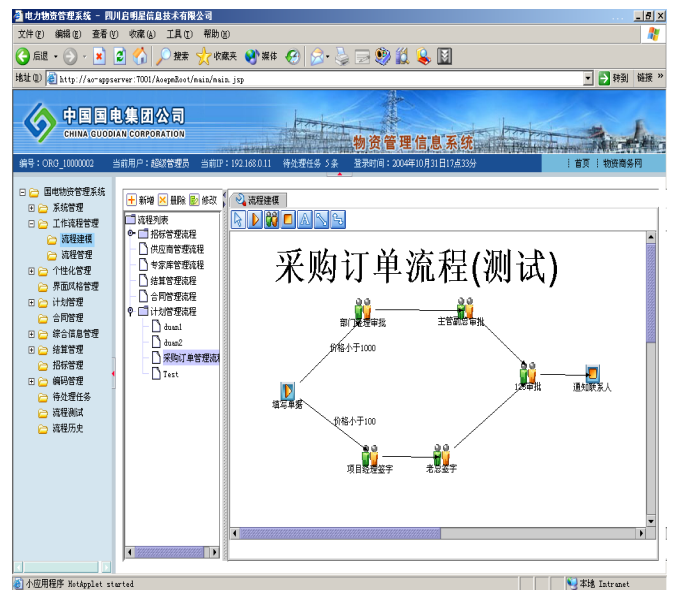


Fig.7. Procedure modeling of the unified material management

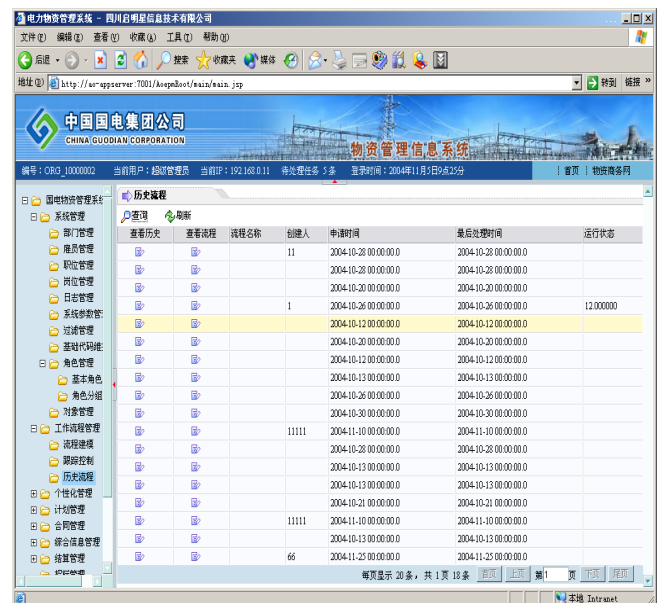


Fig.8. Procedure selection for the unified material management

V. CONCLUSIONS

In this paper, by comparing with the traditional material procedure management, a new procedure modeling

method is proposed for the complex management system of Power Enterprise Group, in order to realize the management system which the guideline is the unified management.

The new procedure modeling method has established a good foundation for the new procedure management, as it is more flexible than the traditional procedure creation. It plays a significant role in the material procedure management. It offers the ability of procedure restructuring for end users, improves the management efficiency, simplifies the management processes, and management works become simpler, quicker, and more convenient. The material procedure management with procedure modeling simplified the complex situations which procedures was very hard to manage, improves the information management, realize the idea of unified management, and so becomes the development trend of the unified material management and other management.

ACKNOWLEDGMENT

The financial support of National Natural Science Foundation Commission of China through project 61174172, 90924302, 60921061, 70890084, 90920305; Chinese Academy Science through project 2F11D03, 2F12E03, 2F11N01.

REFERENCES

- [1] Schaafsma, A. H.; Schrakamp, J. W. Egyptian. Lessons for Materials Management and Purchasing. *IEEE Engineering Management Review*, 1985,13(2): 11-15
- [2] Dongliang Yuan, Yunxiu Sai. The Research on System of Construction Materials Management by Project. 2010 International Conference on Management and Service Science (MASS),2010,1-4
- [3] Juan Zhang. The design of the building materials management system based on B/S structure. 2011 International Conference on Computer Science and Service System (CSSS), 2011, 2702 - 2705
- [4] Ting Wu, Jia-Shu Xu, Zhi-Feng Tan. Engineering Materials Management Pattern Research and Implementation for Generation III Nuclear Power Plant. 2011 2nd International Conference on Innovations in Bio-inspired Computing and Applications (IBICA), 2011,290-293
- [5] Gang Xiong, Tao Qin, Fei-yue Wang Lei Hu, Qing-song Shi. Design and Improvement of KPI System for Materials Management in Power Group Enterprise, The 2010 IEEE Service Operations and Logistics, and Informatics (SOLI 2010). Qingdao, CHINA.2010.7
- [6] Gang Xiong, Lei Hu, Tao Qin, Timo R. Nyberg, Fei-yue Wang, Qing-song Shi. Design and Improvement of the Material Coding Standardization for Power Group Enterprise, ICAL 2010: IEEE International Conference on Automation and Logistics. Hong Kong,

- CHINA, 2010.8
- [7] Neng Wang. Material information management system design in enterprise. 2010 The 2nd International Conference on Computer and Automation Engineering (ICCAE), 2010, (4):521-525
- [8] Ai-Zu Chen, Zheng Cao, Wen Tang. Centralized-Distributed Material Management Mode of Large Enterprise Groups. 2006 International Conference on Machine Learning and Cybernetics. 2006, 2519-2523
- [9] Gang Xiong, Jiachen Hou and Feiyue Wang etc. Parallel System Method to Improve Safety and Reliability of Nuclear Power Plant. The 2011 World Congress on Intelligent Control and Automation (WCICA 2011), Taipei, CHINA, 2011.6.
- [10] XiSong Dong, Gang Xiong, Research on the Construction of Artificial Power Systems. The 2011 World Congress on Intelligent Control and Automation (WCICA 2011), Taipei, CHINA, 2011.6
- [11] Jiachen Hou, Gang Xiong, Timo R.Nyberg, Pekka Hämäläinen. Identification of Vulnerability in Smart Grid Based on Complex Network Theory, 2010 3rd International Conference on Computer and Electrical Engineering (ICCEE 2010), Chengdu, CHINA, November 16 - 18, 2010
- [12] Gang Xiong, Jiachen Hou, Timo R.Nyberg, Pekka Hämäläinen. To Enhance Power Distribution Network Management of Local Power Service Enterprise by using Cloud Platform. 2010 3rd International Conference on Computer and Electrical Engineering (ICCEE 2010). Chengdu, CHINA, November 16 - 18, 2010