

DEVELOPMENT AND APPLICATION OF EQUIPMENT MANAGEMENT INFORMATIZATION IN CHINA

LIU Defeng

Computer Management Development and Application Centre, China Association of Plant Engineering, Guangzhou, 610540, China
e-mail: yuren@china.com.cn

Abstract

Equipment management information system has been applying in Chinese enterprises for over 20 years. In the development and application, in order to solve the problems in configuration of equipment source, keeping higher productivity, controlling equipments running state and depressing maintenance cost which produced in a fast progress, companies in China accepted one of the important thoughts of EAM step by step that equipments and assets are one of the important components of the capital of a company, and based on this, formed and made an EAM system which is different from the western management model and with the characteristics of China, and made the application of EAM in China be in a posture of growing up quickly.

Keywords: Equipment Management Informatization, development status, EAM system, application estimate

1. Development of Equipment Management Informatization in China

Three Stage of Development of Equipment Management Informatization

It began in the middle of 80's of 20 century that companies used management information system in equipment management. In the process of development for over 20, it is a course of going deep that went through CMMS (Computerized Maintenance Management Systems) at first which used the computers in equipment maintenance and arising EAM (Enterprise Asset Management) recently. Summarily, the equipment management informatization can be divided into three stages.

The first stage: Before 1996, the equipment management information systems used in companies were looked as assistant tools, which were characteristics of static information processing, and mostly contained the modules of computerized maintenance management. After 1992, equipment management software abroad came to China, which had the preventive maintenance as a main module.

The second stage: Since 1997, the equipment management informatization went in to a phase of dynamic information processing in network. The main feature is that information processing realized dynamic based on communication of computer network. The main problem of the stage was that equipment management in Chinese companies was in an indeterminate statue under the influence of rapid changing of economic circumstance, especially importing new equipments,

advanced product lines and technologies. So, in the stage, there were over 10 equipment management software productions, which could not solve the important problem of suitability to management practice for the incertitude of management model of system.

The third Stage: It's a stage of starting EAM since 2002, and there are two directions. The first one is native technology providers who mainly service to state owned enterprises. They established some equipment and asset management systems (EAM) by importing advanced management thoughts and management methods, which gave priority to work management and business process control. These systems are based on Equipment Engineering and Life Cycle Management theories, and take design methods of workflow-oriented. Another direction is some foreign software providers who mainly service to joint-venture or overseas investment enterprises, though based on EAM kernel concepts, but the system main functions are preventive maintenance management and work-order type business driving, and their customers are centralized in overseas investment enterprises that have the foreign investment.[1]

Besides the two directions, some providers who are engaged in other software business, main includes some ERP service providers, provide equipment and asset management software modules including in their projects. The main functions of these modules most are early management function of equipment and asset management, which localize on asset accounts management, work records processing, maintenance plans and maintenance expenses management, and equipment and spare parts stock management.

Background of EAM development in China

Chinese industry came through growing up quickly at the end of last century. Many equipment entered an phase of more failures, and maintenance expenses increased also. In new century, more companies attach importance to importing new techniques, new technologies, so that advanced equipment have become an important foundations of innovation and development in the way of industrialization of China. In the course, more and more enterprises realized that equipment management as one of the important management works of a modern enterprises, made a great affect on safe and regular producing and the quality of productions. Especially when a company had a bad equipment management and had to make more equipment devotion to satisfy market requirement, the collision phenomena were engendered between production resources and equipment resources,

like difficulties in production plan, material controlling failure, production supply strain, and so on. These collision phenomena usually induced more equipment maintenance and running cost and lower asset utilization rate. This collision was more conspicuous in those asset-intensive enterprises.

At the same time, Chinese enterprises realized profoundly that it could not solve the problems of competence to only rely on renew equipment. In addition, renewing equipment means cost of huge investment, and the past method to reduce enterprise management cost can adapt the new demand. So, in the last decade, companies took the opportunity and started to seek a whole solution to resolve the problems in equipment management development. It thereby became an important technique and approach selection for Chinese enterprises to apply wildly the information technology and informatization management. Here, it was one of the important courses which must be paid attention to by companies to establish enterprise asset management system (EAM), that provides all-sided data processing functions on equipment and asset resources configuration, controlling of production capacity and equipment running statue. It makes data and information of the equipment and asset management become an important component of information resources of the company, and insure the maximizing the utilization of production capacity in an optimizing management.

On the other hand, since 80s of last century, in the course of reform and open, Chinese enterprises imported western equipment management theories, management methods and techniques from importing western industry technique and industry organization model. And they aimed at modernizing the equipment management, mostly discarded the plan-centered management model in planned economy environment, and formed and founded their management model and management system that are different from the western management model and with the characteristics of China. The EAM system established on this base is also essentially different from Euramerican EAM, and can make a greater help to enterprises and also make EAM to be in a posture of growing up quickly.

Posture of EAM Development in China

Comparably, the main advantage of native equipment management software providers is familiar with the equipment management fact works and management model in companies, who own more professional knowledge of equipment management and equipment engineering technologies and own better service capability, that can provide directly customized service. It is most important that equipment and asset management thought according with the Chinese fact is formed step by step in the course of growing up of native software, for example, attaching importance to whole procedure and life cycle management, running management based on failures and stop analysis, establishing the model of multiple maintenance with priority of preventive maintenance, and development of asset running and economic-technology management, etc. The represent of posture of EAM development in China is in three aspects below:

1. Enterprises have confirmed and accepted the core thought of EAM that equipment and asset is a important component of enterprise capital, and the primary working

object of equipment management is to pursue the asset optimizing and maximizing of capital return. With the guidance of this thought, the work object of equipment management and information system is defined as four main functions: to ensure maximizing of assets productivity, to keep and raise assets capability (function), to ensure the safety of equipment running and minimize the harm to environment, and to pursue the economy of running cost and maintenance expense at the precondition of achieving man-machine harmony.

2. Companies control the whole process of asset management using information system, transfer the running and maintenance information in time, and make the information of the asset management become an important component of information resources of the company. As a result of characteristics of management system of Chinese companies, there are usually 40-50 workflows in equipment and asset management in a company, including about 15 kernel workflows. EAM establishes a digital management platform of equipment and asset management through modeling and simulating workflows, realizes simulating the management organization, intellectualizing management standards, optimizing and reforming business processes, running the management processes in networks, etc. It ensures that the management standards of the company are executed, and all of the asset management information, including the running and maintenance information which is relative to production, becoming an important component of information resources of the company, and resolving the collision problems between production, material purchasing, financial cost and asset management.

3. Companies realize the optimizing configuration among asset resource with technology resources, human resources, fund resource, and material resources by building an EAM management system, and in a whole optimizing management, ensure maximizing equipment productivity. In process of EAM implement, companies in China are usually inclined to forming the competition power of enterprise by attaching importance to optimizing configuration among asset resource with technology resources, human resources, fund resource, and material resources. As a technology system, EAM provides data foundation for these resources integration and configuration optimization, including plans forming, resources demand to implement the plans, warranty of resources correspond, and data support of decision-making, etc. As a management system, depending on the information produced in management actions and information feedback mechanism, EAM realizes the united management of equipment life cycle cost, united organization and configuration of human resources and technology resources in maintenance, united setting up and implementing of the performance examination and management evaluation standards, so that makes management actions and technology actions point to the asset management core target of raising reliability of equipment, and insure maximizing the equipment productivity to obtain the maximizing asset income of capital investment as soon as possible.

2. EAM System in Chinese Enterprises

About 70% of Chinese enterprises, especially large scale enterprises, built and utilized EAM as a relatively isolated information system, and in the course of EAM practice, gradually formed EAM management system and management method that accord with Chinese enterprise facts and equipment management models. The EAM management system and management method in Chinese enterprise, mostly were born out of the main management theories and methods of equipment management and equipment engineering. Using the power of computers in digitalizing and network, it combine the advanced methods and artifices, for example, technology of dynamic business process management, electronic commerce, data analysis, and report processing, etc. These information technologies become the technique basic to improve the traditional management method, and enlarge field of view and range of equipment management. The management system of Chinese EAM is showed in figure 1.

maintenance, reconstruction and updating. (6) Integrating automatically data records of the full procedure of purchasing, installation, running, changing, depreciation, maintenance, service, lubricating scrapping, etc., and forming a whole equipment technologic file including dynamic data.[2]

Establishing Spot Inspection and Failures Analysis Centered Equipment Running Warning System

There is a trend in equipment management in Chinese companies, it is to replace maintenance with management, and to replace breakdown maintenance with preventive maintenance and online maintenance. This demands to put the priority points of equipment management to finding and rectifying hidden troubles, warning and analysis failures, etc. So it is very important to establish a spot inspection and failures analysis

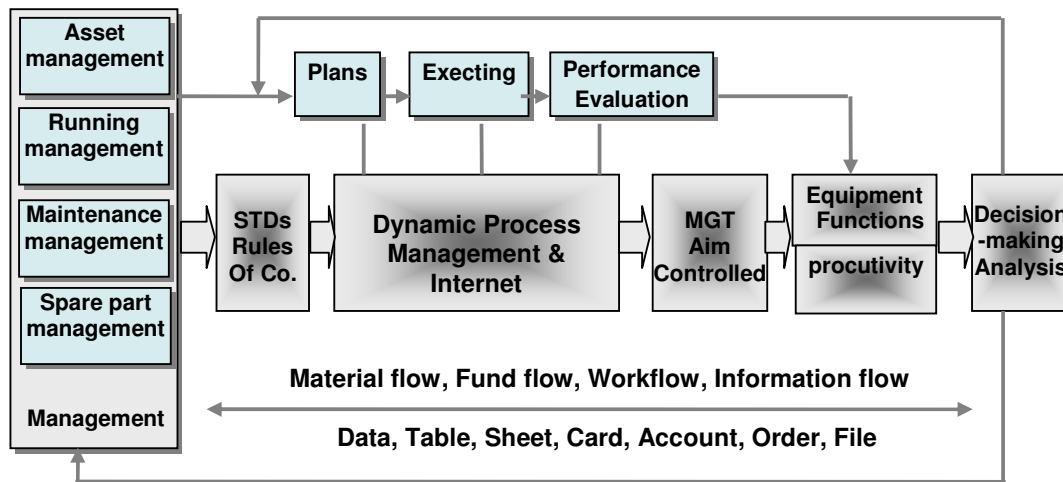


Fig 1 Management System of Chinese EAM

Establishing the Basic Asset Management System under the Direction of Equipment Life Cycle Management Theory

The basic asset management system is some basic and daily works in equipment management, including equipment purchasing and business management, equipment and asset management, management of equipment changing, reports of equipment and asset, etc. These basic management is achieved by following works in an EAM: (1) Setting up standard equipment and asset information structures to ensure the united equipment, running, maintenance, and spare part management. (2) Establishing a whole equipment techniques, management, operating standard information database and knowledge database. (3) Designing of equipment life cycle management model and designing of asset tree. (4) Building up KPI evaluation and analysis system in equipment management. (5) Quantificationally estimation and analysis the equipment economic value performance, running capability, management work quality and efficiency by collecting and analyzing asset period cost to provide support to decision-making of equipment

centered equipment running warning system. Through the regular management and technique methods such as running records, stopping records, spot inspection, perfectness checking, period checking, precision checkout, failure records, accident records, state monitoring, service and lubricating etc., EAM records the past state of equipment and monitors the current running state, from dynamic calculation of MTBF and MTTR, analyzes the reliability and economy of equipment running, provides quantificationally warranty on making reasonable maintenance and service strategies.

The system of equipment running warning is established through using the following methods: (1) collecting and processing the data of equipment running and stopping, (2) creating the failures information database and making failure analysis models, (3) making a controlled management to spot inspection and every kinds of preventive services, (4) evaluating the equipment reliability, (5) collecting and processing the data of equipment state using state monitoring techniques, including vibration analysis, lubricant analysis, infrared detecting, ultrasonic analysis, etc.. [3]

Establishing Modern Maintenance Management System Giving Priorities to

Standard Maintenance and Preventive Maintenance

Being affected by their industries, practices, enterprise properties and technologies, the maintenance methods of Chinese enterprises are characteristics of diversification, and the standardization degree of maintenance is lower. How to improve the standardization management of maintenance and found a maintenance system adaptive to the company by implementing EAM is a core problem in designing and implementing EAM. In this case, the general solution of Chinese enterprises is to build the database of maintenance technology standards and maintenance items standards to improve standardization management and operating regularity. Secondly, different maintenance methods are used in different kind of equipment based on their categories and grades setting, by the approach of categorizing and grading.

1. Equipment category standards: Equipment are categorized in management by relationship between equipment and production, relationship between equipment and quality stability of production, equipment value, safety and environment harm of equipment running, and equipment maintainability (complexity of maintenance, failure frequency, spare part supply), etc. For example, equipment are categorized into A, B, and C. A category means main producing equipment and assistant equipment that can affect production greatly, including linchpin equipment, important equipment, exactitude big rare equipment, main power equipment, main production controlling equipment, equipment with danger to safety and environment, etc. B category includes equipment in assistant product lines and assistant equipment in main product lines. C category is those common and simple. According to the criterion, equipment is valued and categorized one by one in EAM implementing, and made a classification management list, so that managers and maintenance types of every kinds of equipment can be determined based on the regulation of

classified management.

2. The classification of equipment can be looked as the basis of maintenance management classification, and variant equipment are taken variant maintenance types. For example, in metallurgy enterprises, usually, equipment in A category are taken spot inspection & periodic repair and preventive maintenance (PM), equipment in B category are mainly taken preventive maintenance, and as assistance taken predictive maintenance (PDM) and breakdown maintenance (BM), those in C category are taken the management model of breakdown maintenance or failure maintenance.

3. The standardization management of maintenance: Generally, Chinese enterprises attach much importance to building maintenance standards, besides the technique standards and operating standards of maintenance, failure information standards, spot inspection standards, lubricating standards, service operating standards are brought into EAM at the same time. The systematism management standards supporting maintenance service and inspection are formed, to guarantee the standardization and quality of maintenance and service operating.

4. Establishing maintenance program package: Maintenance program package is founded based on optimized maintenance practices, that is to say, the contents and knowledge in an excellent maintenance practice are standardized. A maintenance practices are divided into many repair units, that are turned into admissible maintenance projects and are given the legal maintenance project code. And then these projects can be regarded as the maintenance standards. It is finished to turn the maintenance experiences and practice into knowledge. Procedure of establishing maintenance program package is in figure 2.

After a maintenance practice is standardized and turned to maintenance projects and standards of the enterprise, when this maintenance project should be done, its content norms, technique norms and operating norms

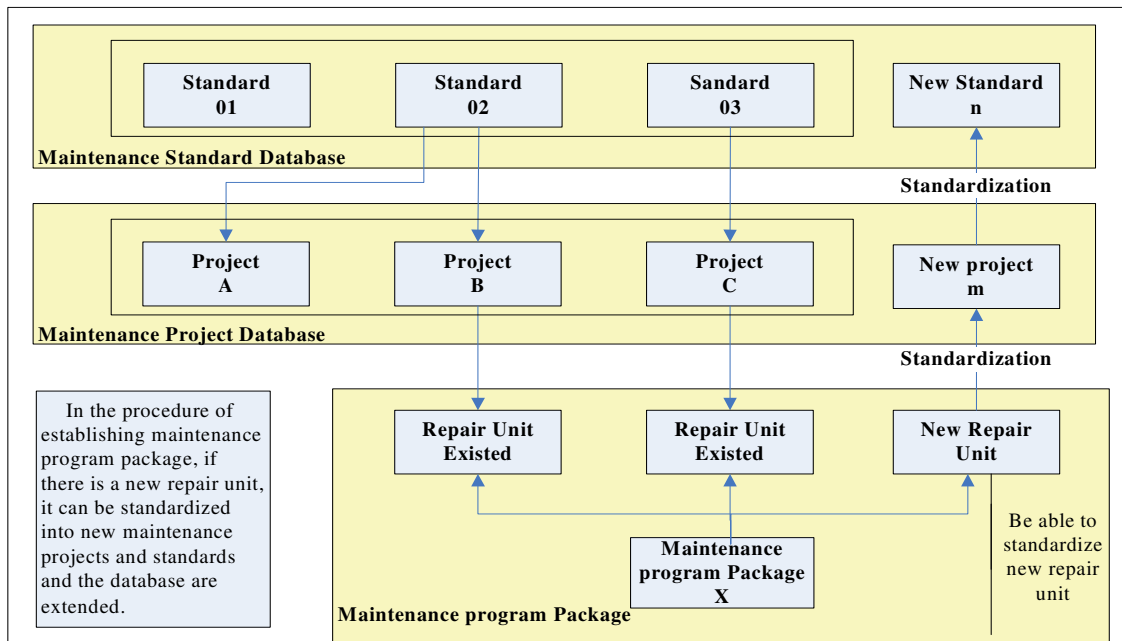


Figure 2 Procedure of maintenance program package establishing

are specific, and have been saved in the information system as the standards of enterprise. All projects with maintenance periods, they are preventive maintenance projects or periodic maintenance projects.

Furthermore, EAM provides model of reasonable maintenance period, model of maintenance resources configuration and model of maintenance analysis, etc. It gives support to arranging human resources according to maintenance project precedence, makes the schedule of maintenance task from enterprise production schedule, and from this calculates and analyzes the demands, stock-filling plan and urgent purchasing plan for spare parts, fund plan, tools plan, etc. to realize the optimum utilization of the maintenance resources.

Establishing Information Management System to Achieve Spare Part Reasonable Stock and Suitable Purchase

It is one of the management objects pursued by Chinese enterprises for a long time to try to reduce spare part stock. But when spare part purchase plan is controlled effectively and purchase quantity adequate to the demand is minimized, stock could be reduced gradually. So, stock controlling must be founded on a base of reasonable purchase plan. And two interdependent approaches to control stock are estimating adequate stock and determining reasonable purchases, and they are two basic points for informatization management of spare parts in EAM. Therefore, in order to pursue adequate stock, it become an important function of EAM to establish analysis models for stock warning, adequate stock estimating, supply cycle analysis, spare part demands balance analysis, etc., and to provide an auto-learning function of stock estimating. Based on these, according to maintenance plans and adequate stock and stock warning, the purchase plans and stock-filling plans can be produced automatically in EAM. EAM supplies combining or splitting or cutout plans, and makes a unitive, timing, regular, reasonable plan and balance processing, to obtain the object of spare part stock controlling by mastering purchase plans strictly.

3. Estimation of EAM Application Effects Management Worthiness of EAM

Equipment management information system is a man-machine logic system, as the other computer application software, its progressiveness and practicability determines the application effects. From EAM effects in Chinese enterprises, the main management worthiness of EAM can be presented into following three:

1. EAM can help an enterprise establish a whole life cycle management model for equipment, a preventive maintenance management model based on spot inspect, a spare part plan controlling model based on reasonable stock analysis, a management object guiding model directed by KPI. Following three unities for equipment management and organization are achieved through the unity of data information: unities management of equipment life cycle cost, unities organization and configuration of human resources and technique resources in spot inspection and maintenance, unities standards of performance estimation and management estimation.

2. Advanced management thoughts, management methods and technique approaches, for example, dynamic management technique of business process, equipment life cycle cost analysis, failure analysis technique, methods for maintenance period analysis and maintenance decision-making analysis, etc., are introduced through EAM to carry out online management and networked organization of all kind of work plans, examination and approval, mission executing, performance estimation, that based on management standards and centered on mission management and mission warning.

3. Optimized business processes, that are around equipment department as the center of mission and resources configuration and carry out flattening, precise and executive ability strengthened management, are founded to provide technology support for optimizing business processes, management process monitoring, business process reengineering.

Investment Yields of EAM

A well running EAM system of enterprise level can produce considerable investment yields. Let's take Xinjiang Bayi Iron & Steel Co. Ltd. for an example, in 15 month after system introduced, the maintenance cost per steel reduced RMB 5.2 Yuan, spare part stock fell 33%, and saved spare part stock fund RMB 48.5 million Yuan, reduced spare part purchasing fund RMB 2.7 million Yuan.

EAM system has a great investment yield for a common company. According to the statistics from Computer Management Development and Application Centre, China Association of Plant Engineering, a company applied EAM can reduce 5-8% of equipment maintenance cost, and after entirely running a year, can reduce equipment breakdown time, and increase 3-5% of continue running time and non-failure running time of primary equipment, at the same time reduce 10% managers, and fall efficiently the synthesis management cost of equipment.

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