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MAINTENANCE VIEWPOINT OF PRODUCT-SERVICE BUNDLE SUPPORTABILITY

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Abstract: The maintenance system can be analyzed in differrentiated manners. It can be considered as a part of enterprise information infrastructure, too. This paper attempts to summarize some of the most important principles of maintenance data management in the field of supportability analysis. Supportability analysis has been viewed as the process of recognizing support requirements for a new system with the purpose to ensure that the technical system will perform as intended. The paper is also directed toward exploring what the maintenance data are to a logistician. It includes additional considerations relating to elements such as product-service bundle database and logistics information system. In short, the paper describes maintenance aspect of the concept of through life information management.

Keywords: Integrated operations management, supportability analysis, product-service bundle database.

1. INTRODUCTION

In recent years, many companies collect and held an enormous amount of data, much of which is unusable or never used. In many companies information are treated and viewed as exclusive responsibility of the management information systems department. The increased complexity of modern technical systems makes maintenance data management of paramount importance. For a long time, maintenance was viewed as a "factory within a factory". Today, there is a trend toward integrating maintenance system within logistics system, although an independent organizational department can exist for maintenance. Because of the increasing degree of automation in operations systems, a high percentage of the employees perform maintenance tasks. The core of logistics processes, such as purchasing, planning, transportation, warehousing, maintenance, etc., can be treated as processes that the materiel is routed through in order to obtain the enhanced operations system capability. In the framework of logistics, maintenance is a process used to keep and restore the equipment to fully serviceable condition.

Maintenance must be an integral part of the logistics and overall business strategy which spans the whole spectrum of activities from product and support design to disposal of equipment. In this sense, product and support design must run simultaneously in scope of concurrent engineering. In the past decade, there has been a dramatic increase in the use of information technology in process of support design. Besides conservative, old-fashioned reactive approach, major current focus is on enabling proactive management of the maintenance. Problem and/or solution information is generated and distributed to users or cognizant organizations without a prior request. Today, a tailored approach is needed to meet anticipated maintenance requirements. The tailoring is taken to be an act of recognizing the specific data requirement that will have the greatest influence on equipment supportability.

2. THE MODERN CONCEPT OF OPERATIONS MANAGEMENT

Operations management has traditionally been observed as the administration of processes that transform inputs (materials, information, energy, capital,) into output (products and/or services) that are valued by customers [2]. Service operations were treated as separate from manufacturing operations. Performance measurement system has provided feedback that may be used to track, monitor, update, and improve the value-adding system. Traditionally, operations management was referred only to as managing transformation processes.

Within the last 20 or so years, the foundation necessary for a global economy has taken shape [8]. In global environment, operations management is about the processes that organizations use to satisfy their customer. As Figure 1 suggests, the modern aspect of operations management integrates service and manufacturing. The basic idea is that most customers expect more than a product or service. In most cases, customers expect a product-service bundle. In other words, they expect a combination or a package of manufactured and service value. Usually, customers don't buy service value and manufactured value from different vendors.

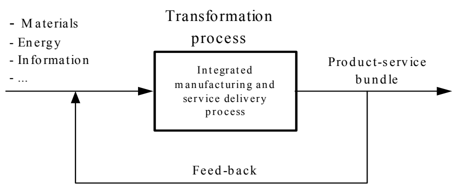

Figure 1. The concept of integrated operations management

Managing operations requires intensive interaction with the other business function. In the age of e-business, operations management is much more integrated with the other functional areas of business. Today, many businesses are managed from a cross-functional perspective.

3. SUPPORTABILITY ANALYSIS

Viewed in its broadest understanding, logistics is business function of generating and maintaining an operational capability. Logistics system is an integrated suite of supply, manufacturing, maintenance and distribution application systems. It brings together several core business functions into one integrated data model to provide for one-time data entry and worldwide electronic access to digital data repositories regardless of its source or location.

The modern logistics system enables the capability to control the store, search, filter, locate, access, view, transfer, up-to-date, retrieval and manage digitalized engineering and maintenance data, providing a framework for reducing costs. The dynamic process of providing logistic support is characterized by the need to respond to continuous changes. The logistic information support allows operations systems to keep up with these changes. Logistics management data come from manu sources and in many forms.

The information infrastructure of modern logistics systems provide:

1. A common user interface consisting of a user-friendly graphical environment;
2. A set of tools for viewing data in various formats;
3. Functions for control of data access and security;
4. Reports generation system; etc.

Thus, logistics information system is a subsystem of the management information system. Logistics information system pulls data from the processes of acquisition, production, maintenance, and distribution and prepares them according to needs. The purpose of logistics information system is to link all facets of the operations system into a cohesive whole.

The use of Internet and Intranet to conduct maintenance and logistics process is the natural outgrowth of the information integration in operations systems. Web based logistics information system, as a means of virtual organising, reduces errors of logistics data collection and helps to move logistics data quickly. Intranet allows employees from different departments to share information and collaborate in logistics and maintenance processes focusing on processes rather than departments.

A common framework for maintenance data management is supportability analysis. Supportability analysis is the iterative process of design, implementing, monitoring, estimating, and adjustment of support system for the purpose to achieve just-in-time availability of support elements in integrated mode. The goal of supportability analysis is to enable optimum system performance at minimum life cycle cost. Supportability analysis includes whole life cycle of system and support elements integration has been accomplished with help of modern information and telecommunication technology. In USA, the field of supportability analysis has regulated by the MIL-HDBK-502 ("Acquisition Logistics Handbook") and MIL-PRF-49506 ("Logistics Management Information") documents (see [3]). In the context of supportability analysis, it is necessary to perform two complementary procedures:

1. Supportability Analysis Records; and
2. Supportability Analysis Reports.

Supportability Analysis Records is a system in form of common relational database used to recognizing, store and sort supportability analysis data in a logical and accessible manner.

The second notion refers to supportability analysis report system and statements that content and transfer data. In short, supportability analysis should be identifying the maintenance activities to be realized and ensure the just-in-time support is procured. Currently, as Figure 2 suggests, supportability analysis is embedded in the modern logistics concepts like a CALS (Continuous Acquisition and Life cycle Support) which presents the world benchmark for exellence in logistics and maintenance management. Thus, logistics aims to integrate the traditional functional responsabilities.

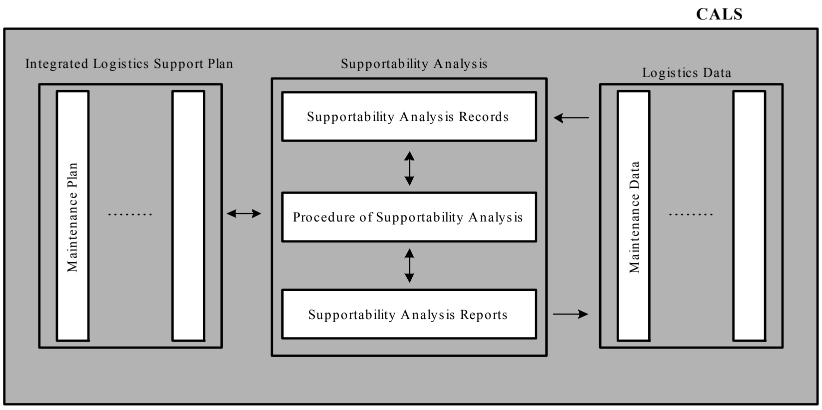

Figure 2. Supportability analysis in CALS environment

Supportability analysis alocates the maintenance levels and determines the maintenance tasks, spares needed, and consumables to be replenished. These data are stored in a maintenance data base.

4. MAINTENANCE-RELATED DATA

Maintenance managers and engineers frequently use data that they did not collect and/or generate themselves. Maintenance data are available from many sites over the world. Management information systems have been seen as more than resources that support maintenance and other logistic processes. They have a potencial that can be used by companies to gain important advantages over market's competitors. The optimal information architecture of maintenance system would be one in which accurate, relevant and timely information could be shared between the various users involved throughout the system life cycles.

Maintenance data which may be shared under computer integrated logistics system are heterogeneous:

1. Engineering drawings;
2. Product data for design and manufacturing;
3. Technical specifications and standards;
4. Resource data;
5. Technical publications and handbooks;
6. Training materials for maintainers;
7. Spare parts descriptions;
8. Maintenance plans; etc.

The key principle is creating maintenance data once and use it many times no matter where it resides. The whole approach is based on sharing digital information. Maintenance staff can have on-line access to all the supporting information. Those data may be electronically fed back to maintenance engineers and managers for analysis and predicting of future maintenance requirements. The collection and analysis some of maintenance data (e. g. materiel, spare parts, etc.) support the purchasing process.

Throughout the spectrum of supportability analysis, a basic kinds of maintenance data are associated with items such as the following:

1. Exploitation and maintenance requirements;
2. Reliability and maintainability characteristics;
3. Failure mode, effects and criticality analysis;
4. Human resource requirements;
5. Support equipment data;
6. Infrastructure description; etc.

The just-in-time availability of maintenance data via CALS make the comprehensive and customizable logistics management possible. Thus, there are three types of maintenance data access [4]:

1. No access;
2. View access; and
3. Full (generate-change-delete) access.

Maintenance and engineering computer applications have been created on the basis of very complex and semantically rich information models. In non-integrated operations systems, each data change in primary application, usually CAD (Computer Aided Design) system, provokes the additional activities for other applications updates. The consequence is that designers, manufacturers, and maintainers do not have control over product databases. As Figure 3 highlights, the solution of described problem has been given by integrating operations system in which computer supported engineering processes (CAM – Computer Aided Manufacturing, CAP – Computer Aided Planning, CAQ – Computer Aided Quality, SA - Supportability Analysis, CMMS – Computerized Maintenance Management System, …) have integrated around product-service bundle database.

Maintenance information flows should be synchronized and feedback loops should be defined to measure maintenance system performance. A comprihensive maintenance database should be three dimensional and include general information on the technical system type (specifications, parts lists, standard maintenance procedures, ...), information on the concrete technical system (maintenance history, failure modes, costs, ...), and location of the asset.

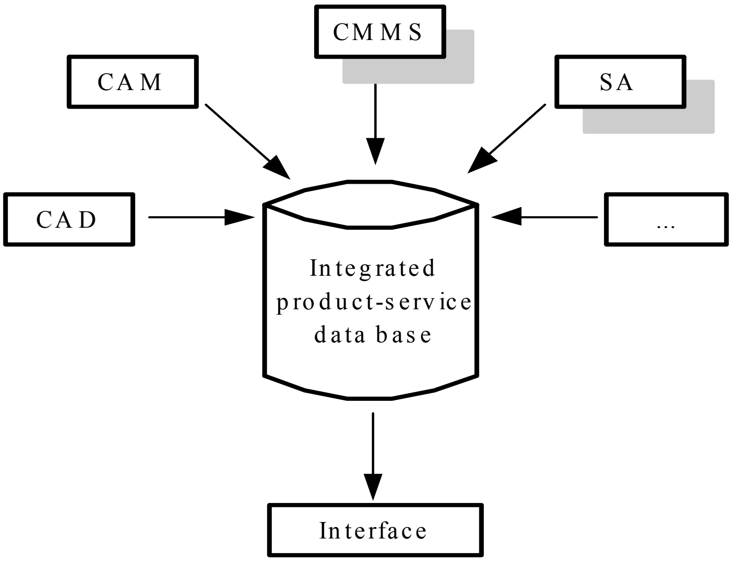

Figure 3. Integrated product-service database

5. CONCLUSION

Information systems serve as facilitators between management concepts and information tehnology. The maintenance data management has been discussed in connection with supportability analysis. The result of this paper indicates that the maintenance data management is an inherent feature of supportability analysis. Supportability analysis is an impressive analytical tool for gaining full spectrum supportability over entire life cycle and an integral part of the system engineering process. It incorporates maintenance tasks requirements into design and provides answers to maintenance and logistics questions.

The key to maintenance exellence is the ability to share maintenance and logistics support data. A shared data environment is an basic component of overall logistics strategy. Another advantage of this technology is that any Web browser can read such forms. This Internet-like capability significantly increase access to information. The direct benefits would come through reductions in maintenance costs, with significant enhancements in equipment performance.

Finnaly, advances in information technology are transforming the way maintenance and logistics are managed and offer opportunity for improved control over the entire logistics system. This would be lead to full optimisation of the logistics process rather than the emphasis sub-systems within the logistics organisation generating partial optimization and total sub-optimal performanse. Off couse, total logistics system optimization is truly attainable only in a very idealized environment. Considering this, we have an opportunity to create the next generation of maintenance systems. The consequences of these changes will be reflected in corporate profits and in the national economy.

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