Chapter II

Literature Survey

In order to create the Decision Support System for maintenance planning, this research involves with two major areas: Maintenance and Decision Support System.

2-1 Maintenance

Barlow and Hunter (1960) presented two preventive maintenance policies suitable for the simple and complex equipment. The first policy performs maintenance task at the specific time or when the failure occurs. Then, the maintenance task is rescheduled. The second policy performs the task as same as the first policy, but the schedule is not changed. The second policy indicates that the maintenance work at each failure is only the minimal work and does not effect the failure rate of equipment. As a result, the schedule remains the same. The results of developing these two policies are the optimal models for identifying the expected costs and time for maintenance policies.

Zijlstra (1980) presented the objective functions for optimizing two maintenance policies. These two policies were used for the units where performance levels decrease with time. The first policy was called the age replacement and age maintenance where a unit is replaced or maintained when it fails or at age T. The second policy was called the block replacement and block maintenance where a unit is replaced or maintained at failure and at times 0, T. 2T, ... The objective functions were used to define: (1) the suitable number of units used, (2) time for maintenance, (3) and age of units, under criteria of replacement costs, maintenance costs, and failure rate.

Nelson (1982) presented the relationship between the Weibull distribution and the smallest extreme value distribution. This relationship is used in analyzing the data and estimating the parameters in the Weibull distribution. By using the mean and standard deviation of the sample data, the scale and location parameters of the extreme value can be estimated. These parameters are used in estimating values of the scale and shape parameters in the Weibull distribution. He also presented the equations for calculating the confidence limits and suggested the appropriate number of samples for estimating these parameters.

Christer and Whitelaw (1983) presented the approach to the problem recognition in breakdown maintenance. They suggested that a mismatch between the collected information and required information effected the efficacy of maintenance control. Three main areas, the cause of fault, the consequences of fault and the means of prevention, were presented for use in defining the maintenance problems. The two case studies were presented in order to show the practicability and guidelines of this approach. Data were collected in the form of frequency of failures and downtime, and be grouped by the characteristics and causes of failures. Information was analyzed and presented in the histogram model. This can help managers to recognize the problems. Although this paper focussed on only the scope of breakdown maintenance, the area of information in this approach, such as means of prevention, can be linked and applied to preventive maintenance.

Mann (1983) presented the overall concepts of the maintenance management from the objectives, the importance to the implementation. He explained the concept of the corrective, preventive and contract maintenance. He gave the guidelines for building the maintenance system by discussing the several of techniques regarding maintenance. These techniques are the maintenance planning and scheduling, the maintenance work measurement and standard, the maintenance budgeting and forecasting, the maintenance work training, and the maintenance indexing for performance measurement. He also suggested the statistical and computer tools for applying in the maintenance system. For the maintenance planning and scheduling, he suggested that there are many factors to be identified before planning the maintenance works. These factors are the priority in the maintenance works, the required workforces and work hours, the list of parts and equipment, and the other special consideration.

Kelly (1984) developed the procedure for maintenance planning of the different operations. He suggested the issues to be considered before maintenance planning. These issues are the items, the maintenance costs, and the maintenance procedure of the items. He presented the methodology in establishing the maintenance plan and schedule. He explained about the maintenance organization. The responsibility and authority in the maintenance are concerned in the maintenance organization. He discussed about the documentation system for implementing the maintenance plan. He also showed the case studies for both manual and computerized documentation systems.

Berger (1987) presented the maintenance management system for minimizing the downtime and maximizing the utilization of resources. The system composes of the four major components: work order control, preventive maintenance, inventory control, and equipment history. The work order system concerns with

the maintenance work standards, the description of work, the work priority, and the maintenance management activities. The examples of maintenance management activities are scheduling, ordering, reporting and recording the maintenance works. The preventive maintenance system involves with identifying, scheduling, and reporting the preventive maintenance activities for equipment. The inventory control system considers in supplying the equipment and spare parts to support the maintenance works and minimizing the storage and handling costs. In this component, the spare parts and equipment are listed, categorized, and recorded their usage for the inventory level and turnover control. The equipment history keeps the records of the maintenance data for supporting maintenance management. The types of maintenance data recorded are the equipment downtime, the machine specification, the operating manual, the preventive maintenance lists, and the maintenance work orders.

Pintelon and Gelders (1992) discussed: (1) the role of the maintenance management as a business function and a suitable system for the maintenance management under the different manufacturing conditions, (2) the decision making in maintenance, strategies, plans and objectives and (3) the computer tools and the operation research techniques used for the decision making. They presented three levels of decisions in the maintenance management: the strategic, the tactical, and the operational planning. The strategic planning concerns with the replacement of the equipment or machine to maintain the competitive capabilities of the company. The tactical planning considers the different maintenance policies in optimizing the corrective and preventive maintenance. The operational planning involves with the maintenance job planning and scheduling. They suggested the guideline for further study in optimizing the maintenance policies.

Lewis (1996) presented the method in estimating the parameters of the Weibull distribution. By applying the extreme value distributions, the shape and characteristic life parameters of the Weibull distribution can be estimated. He explained the relationship between the minimum extreme value and the Weibull distributions. From this relationship, he presented the equations to estimate the parameters of the minimum extreme value distribution. Then, he explained the procedure to transform the extreme value parameters to the Weibull parameters.

Duffuaa, Raouf and Campbell (1998) discussed about the integrated maintenance system. They emphasized on the application of the quantitative techniques for operating, controlling and improving the maintenance system. They presented the approaches to design, organize and control the important components of the system. These are the work order system, the corrective and preventive maintenance concepts, the work standard, the maintenance load

forecasting and capacity planning, the job planning and scheduling, the material control, the quality, the indexes and the performance measurement, the training, and the system audit. They also discussed about the techniques in computerizing and the continuous improvement of the maintenance system. For the concept of optimizing the breakdown and preventive maintenance, they presented the application of the mathematical models developed from the maintenance policies of Barlow and Hunter. These models are used to determine the appropriate time and costs to perform the preventive maintenance tasks for minimum total costs. In the maintenance planning and scheduling, they suggested the effective procedure and elements in setting the maintenance plan and schedule. They also suggested the techniques, such as the mathematical programming, to use in the maintenance scheduling.

Nagarur, Keawplang and Batanov (1999) presented the methodology to create a computerized maintenance management system by applying the object-oriented approach. They presented the framework for developing the maintenance management system. The components in the framework are consisted of the maintenance context, the maintenance core, and the maintenance software. The maintenance context is the environment of the maintenance system. They are the system that supports manufacturing and the other external factors. The maintenance core is focused on the functions of the maintenance manager. The examples of these functions are setting the policies, maintenance planning, organizing, budgeting, and controlling the maintenance activities. The maintenance software provides the tools for decision making of the maintenance. It supports the information and reports to a decision-maker. They also suggested the methodology in designing the information system that is consisted of the two phases. These are the analysis and the design phases. In the analysis phase, the maintenance functions are analyzed and broken down into function tables. These tables are used to create the information model in the design phase.

2-2 Decision Support System

Turban (1988) discussed about the subsystem components in the decision support system. These components are the data management, the model management and the dialog subsystem. He suggested the required capabilities and the roles of data management component for the DSS. In the model base management subsystem, he presented the structure and functions of the model component for the system. He identified the functional requirement of a dialog or user interface for building the DSS. He also classified and explained the types of DSSs and their support for the different objectives.

Watson and Sprague (1993) presented the components of the decision support system architecture and their relationships. The components of the DSS are the dialog, the data and the model. In the dialog component, they discussed its importance in interacting with the users in order to inform how to use the system. They concerned with the knowledge base that contains the information for supporting the user decision and the procedure to use the DSS. They also discussed about the action language for controlling the system and the presentation language for presenting information to users. In the data component, they concerned with the sources of data, types and characteristics of data, and database used in the system. In the model component, they discussed about the types of model to be used in the system and the approach of the system to use different models.

Sauter (1997) explained the DSS by integrating the theory and practice. She presented the approach to build the components in the DSS architecture by applying new tools and techniques. The concept of data warehouse is introduced to use in the data component. The database management system is presented in the different types of structures. For the model and dialog components, she introduced the application of the object-oriented technology for developing the DSS instead of using the traditional programming languages. She also guided an approach and procedure for designing the DSS.