Computer Aided Maintenance

By

AHMED HESHAM MARZOUQ

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Supervisor

Dr. Mamdouh Mansour

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Abstract

Significant advances in computer hardware and software development have affected most areas of business and industry, and the area of maintenance planning and management is no exception. The use of computerized maintenance management systems, which are commonly referred to as CMMS, is no longer a luxury or frivolous business overhead; in many cases, it is requirement. Enterprises that want to attain ISO, QS certification will discover that application of CMMS is a fundamental requirement to successfully obtain and maintain such certifications.

A variety of software packages are available, and many have been around for a number of years. Today, CMMS are used for all aspects of maintenance planning, management and control. CMMS must be flexible and adaptable, because every firm is considered unique. A general guide has been developed, which can easily be applied to specific situations to assist in justifying the computer for Maintenance System Evaluation (MSE). MSE has always required the manipulation of large

amounts of data and development of more cost-effective processing storage and database systems has brought the use of computers to the fore in this area. Since, the relationships are complex between factors affecting maintenance activities and their interactions; a computer-aided model is developed with main purpose of determining the evaluation factors and their pointers. This model will approximate the complex relations for practical purposes. A model with eight various factors and there pointers for MSE were proposed in this paper. The MSE approach uses the input data as well as the factors that reflect unique operating conditions and specific objectives of the firm. The model would help in measuring the effectiveness of maintenance activities in order to determine the deviations from the planned work. It will also perform instant corrective actions required according to the degree of deviation and its effect on the production continuation and with the minimum shutdowns possible.

1. Introduction

In today's global economy with fierce competition to attain and maintain the competitive edge in productivity

and quality, a key factor often is neglected. The planning and management of productive maintenance activities in industrial manufacturing organizations rarely are given the attention they deserve Stephens. Many solutions are being exposed, such as future automated factory, zero inventories and integrated manufacturing system. These solutions cannot be successful without highly reliable machines and equipments.

Two issues regarding computer-aided maintenance are addressed: The first is fundamental knowledge, including both theories and methodologies required for practitioners to perform maintenance activities effectively. The revolutionary advances in information telecommunication, and computing technologies at modern factories forced the need for new approaches in process design, materials management, technologies, and human resources. The second and equally pressing issue is to understand how to implement the right maintenance tools and techniques, based on the introduced theories and methodologies, to solve problems in a very short time in order to guarantee success Lee and Wang. Today, leading firms understand

the necessity of linking production planning with resource supply using dependent demand techniques like Enterprise Resource Planning (ERP) in order to provide the increasing business needs in more effective and efficient ways.

The knowledge that has been gained in linking production with maintenance planning is essential to compressing the computer- aided evaluating system for maintenance activities. Applying this knowledge will help reduce waste and greater productivity. It became apparent that maintenance was not just about keeping machinery in a good working order but it involved learning by sharing communal experiences, and feeding the result back into design, operation and maintenance itself .Maintenance has always been in the business of dealing with large amounts of data. The advent of the microcomputer in the late 1970s began a revolution in maintenance systems.

Lee and Wang and Candy both suggested that the overall goal of the maintenance function is to make capacity available to production in a reliable and stable manner. This should enable organizational objectives such as the

following to be met; 1) Responsive customer service, 2) Consistent product quality, 3) Reliable product output, 4) Cost efficient operations, maintenance and supported departments, and 5) High utilization of equipment and other resources.

2. Experimental Measurements

Traditionally, maintenance organizations have operated in a “fire-fight” mode. “Preventing fires” has often been given a minor or causal emphasis.

The fire-fighting mode (fix it when it breaks) is called Corrective Maintenance, while the latter (fix it before it breaks) is called Preventive Maintenance (PM) as shown in Fig.A1 appendix Lindbeck and Wygant, and Burton et. al. . A key distinction among these three perspectives relates to the time interval between the recognition of the need to perform a maintenance activity and the time the maintenance activity is performed.

3. Evaluating Factors Scoring for Maintenance Activities

The evaluation approach of maintenance activities usually categorizes a given maintenance system by scoring its activities more often on a scale of one to four.

The higher the category scores for a factor, the greater the importance of the other categories. This is usually done with the objectives of:

• Labor usage efficiency improvement.

• Unexpected breakdowns reduction.

• Downtime reduction.

• Maintenance scheduling improvement.

• Preventive maintenance program improvement, Dhavale and Otterson:

The user has the choice to eliminate some of the factors entirely, adding new factors, changing, adding or deleting pointers in a given factor and changing their scores. The user should examine critically according his firm conditions.

4. Measuring System of Maintenance Activities

The main objective for measuring and evaluating maintenance activities in a firm is to determine the followings:

I. Performance level of maintenance system.
II. Deviations from maintenance plan.

III. Required corrective actions.

Different evaluating systems to maintenance activities have been developed in industrial countries (Ettlcin and Jahing, 1986, Mann and Coates ,(Simith and Malek and Kaitan. Any firm can use an evaluating system according to nature of their industrial function. Some of these systems used on the national levels such as, The English system used in automobile industries , The American system used in engineering industries , The Egyptian system used in chemical industries, The Soviet system used in metallurgical industries , The Yugoslavian system used in mechanical industries and The English system used in batteries industry. All of these systems for measuring and evaluating maintenance activities are used to annually evaluate the efficiency of maintenance plan execution according to certain determined goals.

5. Case Study

The English system used in battery industries has been applied in the one of the Middle East companies called General Company for Liquid Battery Industries. A computer program written in visual basic was built as an evaluation system for maintenance activities in this

company and the results for each factor and their pointers are compared with the standard values at “Chloride” company. It was found necessary to modify it with regard to:

I. Factors and pointers for planning efficiency.
II. Factors and pointers for loading efficiency.
III. Factors and pointers for costs.
IV. Factors and pointers for productivity.

The modified approach in applying “Chloride” system is based on identifying two pointers for each factor. This modifying method depends on four parameters, which reflect the own production environment of battery Industry Company as follows:

I. Size of company and the type of functional organization to production department.
II. Varieties and continuity of production type.
III. Work nature, time and operating environment.
IV. Skills, number, stability of maintenance workforce.

The actual measured values for the major (4) factors (planning, loading, costs, and productivity) depend on the determined pointers for each factor. These eight

pointers represent the basic for measuring the maintenance activities. A flow chart that illustrates the algorithm steps required for measuring the efficiency of maintenance activities in the chosen company is shown in Fig.1 below.

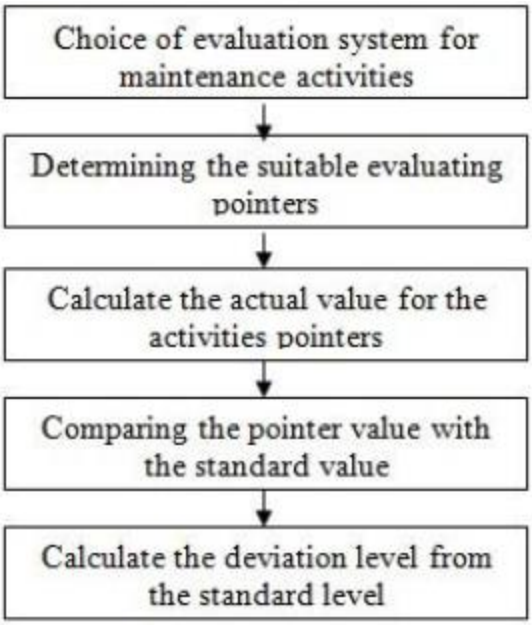

Figure 1: Flow chart of the steps of measuring maintenance activities efficiency

Planning Efficiency Factor Calculations:

Workforce effectiveness (LE) Pointer:

L.E = (Z-Q) / Z x R

Where:

Z= Total operation hours,

Q= Total absenteeism hours,

and R = Workforce skillfulness average.

The calculation procedure for LE is shown in Fig. 2 below.

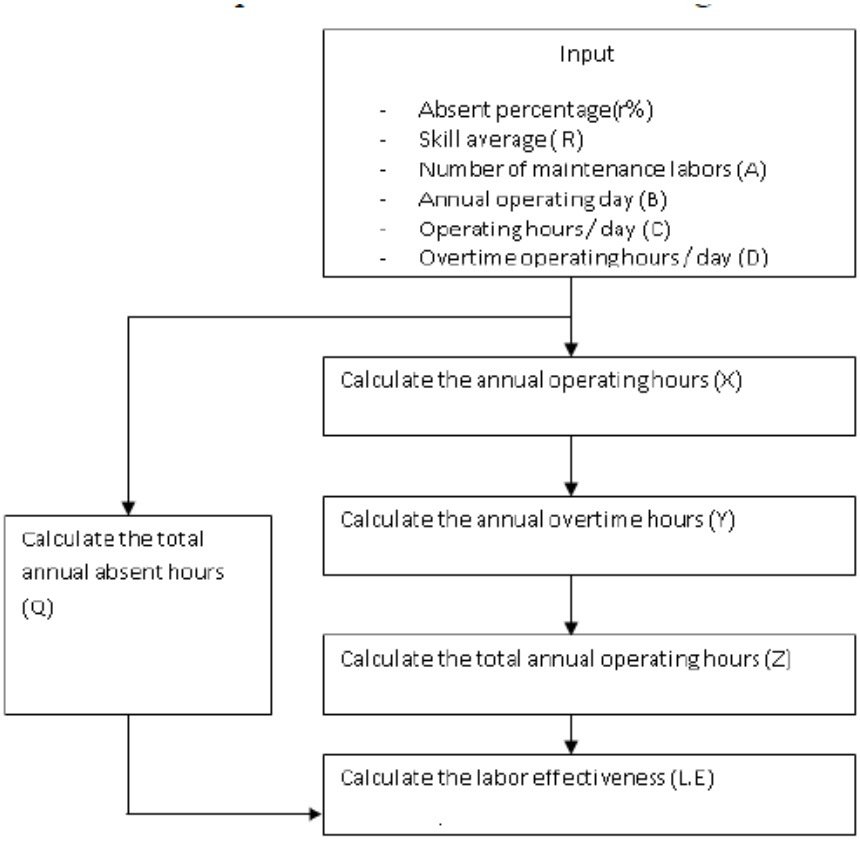

Figure 2: Calculation procedure for labor effectiveness.

Executed Maintenance Work/planning maintenance Work Pointer (KT):

KT = BT/AT × 100

Where:

BT = Number of actual maintenance hours,

AT = Number of planned maintenance hours.

The calculation procedure of KI for each department and KT for the overall company is shown in Fig. 3 below.

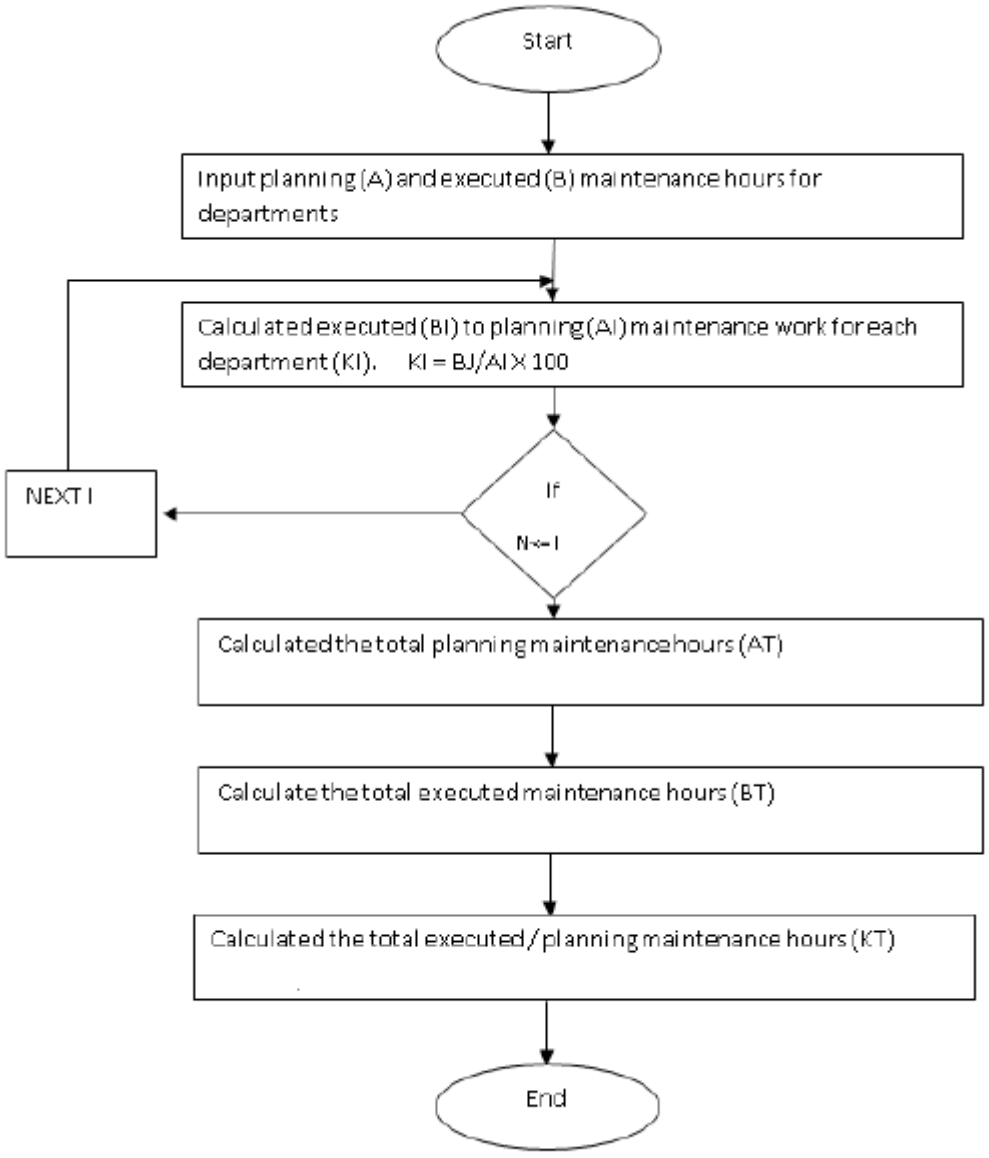

Figure 3: Calculation procedure for executed / planning maintenance hours.

6. Results Analysis

The deviations of maintenance activities measurements from targeted levels resulted from comparing the actual results with standard values. These deviations for the selected factors and their pointers are illustrated in Table 1. The lack of labor effectiveness (LE) ranked as the first one as the actual value is (58.5%) while the standard value is (80%). Which means a deviation value around (58.5-80=-21.5%). The production breakdown pointer for maintenance has actual value of (7.8%) with a deviation value of (7.8-3 = 4.8%).

Table (1): Results of MES maintenance activities factors and pointers.

Factors	Pointers	Pointers Values			Factors Values		
		Actual Value %	Standard Value %	Deviation	Actual Value %	Standard Value %	Deviation%
Planning	Workforce Effectiveness	58.5	80	-21.5	56	82.5	-26.5
	Actual Maintenance Work / Planned Work	53.5	85	-32			
Loading	Preventive Maintenance Hours / Total Maintenance Hours	18.5	25	-6.5	50	50	0
	Corrective Maintenance Hours/total Maintenance Hours	81.5	75	+6.5			
Costs	Total Maintenance Costs / Capital Investment	6.5	6	+6.5	38.25	45.5	-7.25
	Direct and General Maintenance Cost / Total Maintenance Costs	70	85	-15			
Productivity	Labors Utility	67	75	-8	37.4	39	-1.6
	Breakdown Time / Total Operating Time	7.8	3	+4.8			

7. Conclusion

Maintenance management may be a key strategic variable in the quest for waste that will lead eventually to strong competitive advantage. Leading companies understand the necessity for linking production planning with maintenance planning activities in order to reduce waste. Waste is inherently greater if production and maintenance plans are not linking, made poorly or not followed closely.

The knowledge that has been gained in linking production planning with maintenance planning is essential to for a proactive maintenance program. And it also essential to compressing the computer-aided evaluating system for maintenance activities. Applying the knowledge will help in reducing waste and greater productivity.

8. Preferences

1. J. Carter, “Maintenance Management-Computerized Systems Come of the Age”, Computer-Aided Engineering Journal, 1985.
2. Hossam A. Gabbar, Hiroyuki Yamashita, Kazuhiko Suzuki, Yukiyasu Shimada. “Computer-Aided RCM-Based Plant Maintenance Management System” Robotics and Computer Integrated Manufacturing.