I / We Confess I had read
this work and for me / us, this work is qualify
enough of being rewarded for
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DEVELOP AND PROPOSE AN OPTIMUM MAINTENANCE SCHEDULE FOR A CRITICAL MACHINE AT INDUSTRY

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"I confess that this report is my own work except the abridgement and extract each of it I had explain the source"

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MY APPRECIATION GOES TO PEOPLE
WHO INVOLVE IN THIS PROJECT

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ABSTRACT

In an industrial setting, problems routinely arise that require making the best possible decision or solution. There are many factors that affect reliability and there are many issues that must be addressed. Two related issues in that highlighted in this report are product reliability and maintainability which deals with maintenance issues. This report intended to provide a sample reliability studies done in real-life situations that is actual applications with use the failure machine real data, addressing real problems and arriving a solutions that can be implemented. The cases that had been studied are using the statistical approaches and illustrate many approaches which were taken to modeling, analyzing, estimating, predicting and improving the case.

ABSTRAK

Di dalam industri, masalah sering berlaku dimana memerlukan jalan penyelesain yang terbaik untuk menyelesaikannya. Terdapat beberapa faktor dan isu yang memberi kesan terhadap keboleharapan sesuatu produk atau sistem dimana perkara-perkara berikut perlu diperbincangkan. Terdapat dua isu yang difokuskan di dalam laporan bertulis ini iaitu isu keboleharapan produk dan kebolehselenggaraan di mana ianya berkait rapat dengan isu penyelenggaraan. Laporan ini dilengkapi dengan kes berkenaan kebolehtahanan sesuatu produk di mana ianya berlaku di dunia sebenar dengan menggunakan data kegagalan mesin yang sebenar, masalah yang berlaku dan jalan penyelesaian yang boleh diambil dengan menggunakan pendekatan statistik.

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σ	=	Standard Deviation
β	=	Weibull Parameter Shape
θ	=	Characteristic Life
λ	=	Failure Rate (lambda)
σ^2	=	Variance
t	=	time
e	=	exponential
R(t)	=	Reliability
MTBF	=	Mean Time between Failure
MTTF	=	Mean Time To Failure
RBD	=	Reliability Block Diagram
FTA	=	Fault Tree Analysis
OTF	=	Operation To Failure
PM	=	Preventive Maintenance
VAR	=	Variance

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CHAPTER 1

INTRODUCTION

This study had been conducted through the whole year in order to develop and propose an optimum maintenance schedule for a critical machine at industry and need to study the previous record of the maintenance check sheet for a machine.

1.1 Project Overview

Preventive maintenance is done in time available in an attempt in order to avoid costy failure later which the maintenance activity includes cleaning, adjusting and recognizing incipient failure before they occur. For every maintenance that done towards the machine it will be recorded in a maintenance schedule form which followed the timing of the inspection either yearly, monthly, weekly, daily and hourly follow the frequency that needed. Maintenance schedules are a plan or schedule that detail when work, either major or minor which need to be completed. The maintenance activity can be required simply because of the age of the machine which sometimes users do not expect the failures until the components or the systems of the machine fails. When a part of the components in the machine fail, it will affect overall the machine functional which will bring to downtime.

The optimum maintenance for every machine in industrial is very important to every factories in order to minimize the maintenance cost and to ensure that the machining system always in good condition and good performance.

This study had been conducted towards a double-sided planetary lapping and polishing machine that had been used widely in disc manufacturers. This polishing machine capable of processing a wide variety of materials to very exacting tolerances of thickness, flatness, parallelism, and surface finish and also capable of processing parts as small as 1/8” in diameter up to 72” in diameter. The machine itself has seven main components which are belting motor, pump, wiring parts, cylinder alignment, upper plate lock, plat flatness and sun-gear.

In order to fulfill this study, the polishing machine maintenance data had been collected based on machine operation real data for past two years (2008 and 2009). The data collection is focused on the failure component machine that had been recorded for overall machine operation period. All the data then need to analyze and process by using a suitable method in order to get the result for this study.

1.2 Problem Statement

i) Reliability is one of the most important characteristics defining the quality of a product or system. High reliability is achieved through design efforts, choice of materials and other inputs, production, quality assurance efforts, proper maintenance and many related decisions and activities, all of which add to the costs of production, purchase and product ownership. On the other hand, lack of reliability can also lead to significant costs.

ii) Preventive maintenance (PM) is done in time available in an attempt in order to avoid costy failure. However users do not notice the incipient failure of one machine yet before its getting worst in time. The machine failure is cause by many reasons either directly or indirectly. All the failures are obtained from the workers themselves, less machine maintenance, machine testing and machine inspection.

iii) Reliability and optimization engineering had try to study, identify the procedures and analyze the failure in the machine system restoration in order to improve the machine operation so that it will increase the

lifetime and to decrease the failure probability and machine failure to prevent the machine from breakdown.

1.3 Scope of Study

This study only conducts for a double-sided planetary lapping/polishing machine. The status of each components in the polishing machine is determine by study and analyze it's failure history for past two years (2008 and 2009) by referring to the machine maintenance schedules. By doing this one can predict the future failure which might be occur for the components in the machine so that the preventive maintenance (PM) can be done before the failure time.

1.4 Objective of Study

The objective of this study is as follow:

i) To develop and to propose an optimum maintenance schedule that will indicate the right time to do maintenance for a critical machine at industry by using statistic approach (Weibull Analysis).

In order to achieve the objective of the study:

i) Need to find the critical machine in the industry and get the machine failure data in order to study the history of the machine failure, the pattern of machine failure and to identify the critical components in the machine.

ii) Analyze and process the failure data by using statistic approach (Weibull Analysis).

iii) Need to propose the preventive maintenance which will indicate the right time to do the maintenance for the machine.

CHAPTER 2

LITERATURE REVIEW

The development in the manufacturing industry has maturated maintenance services. Maintenance in the past has been looked at as the unnecessary in industries but nowadays, maintenance is part of the production process which manufacturing firms look at maintenance services as part of their core business (Dhillon, 1999). Ikhwan and Burney (1994) wrote “as the technology has advanced, sophistication of all man-made machines and system has grown and, with that, the nature and needs of maintenance have drastically changes. Gone are the times when maintenance was considered “a necessary evil” or managers were contented even if all the profits went to maintenance. Maintenance function has become not only more technical, more scientific and more complicated, but also more prominent, more pressing and more paying”.

2.1 Maintenance

Maintenance, repair and operations is fixing any sort of mechanical or electrical device should become out of order or broken as well as performing the routine actions which keeps the device in working order (schedule maintenance) or prevent trouble from arising (preventive maintenance). According to Dhillon (1999),

traditional maintenance actions consist of repair and replacement activities. However, in addition to these two commonly accepted maintenance actions, there are many other actions that can be used as a maintenance response to combat machine degradation and failure. For instance, when a machine is severely degraded, the throughput setting of the machine can be lowered so that the machine runs in a less loaded state which decelerates its degradation. As the degradation is slowed down, the machine can stay in production, albeit at a lower rate, until a repair or replacement action is ready to be performed. By doing so, repair or replacement can take place in a more favorable time frame giving the maintenance crew adequate time to prepare the resources needed for such actions. With enough preparation maintenance actions can be performed in a more efficient manner, using less labor and or time, while also making the machine more available for production.

The operation and maintenance phase is concerned with the task related to the maintenance, management of the engineering and the support of the system over its operational life period. Some of the reliability and maintainability related management tasks involved during the operation and maintenance phase as follows:

i) Developing failure data banks
ii) Analyzing reliability and maintainability data
iii) Providing adequate tools for maintenance
iv) Providing appropriated manpower
v) Managing and predicting spare parts
vi) Preparing maintenances documents

The maintenance function is normally a secondary function for a production firm. The function of production or operations is to produce or to manufacture a raw input. In the other hand, the function of maintenance is to maintain the capacity of the production function. In other words, production’s output is the product itself; maintenance output is the capacity to produce as shown below.

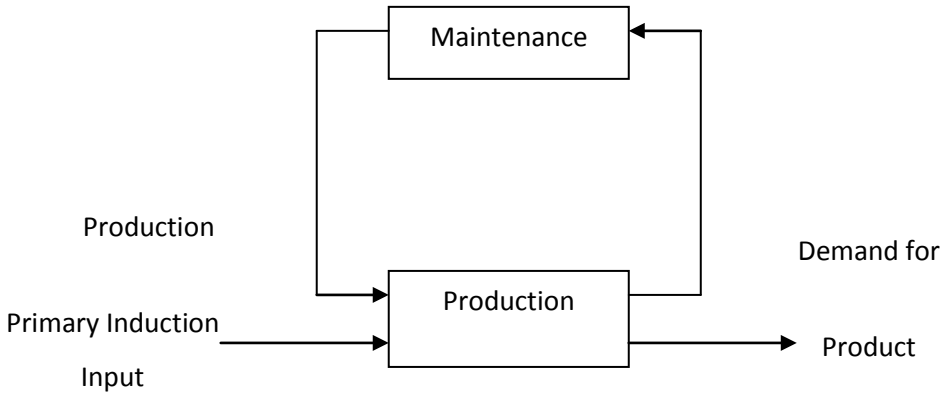


Figure 2.1: The relationship between maintenance function and production functions. (Source: Ben-Daya and Duffua, 1995)

In (Arts et al. 1998), maintenance is a supporting function in any organization, especially an industrial one. It is part of the production process that transforms raw materials into final products.

According to Zhu et al. (2002), The business goals of the maintenance process are:

i) To increase primary process capability
ii) To improve primary process performance such as quality, profit, etc.
iii) To satisfy regulatory requirements, such as safety, hazards and environmental standards in a cost effective manner

For Higgins (1995), maintenance function is a science and an art. It is a science since its execution relies on most or all the sciences. It is an art because seemingly identical problems demand and receive varying approaches and actions and because some managers, foremen, and technicians display greater aptitude for it that others show or even attain

2.1.1 Maintenance Schedule

Maintenance schedules are a plan or schedule that detail when work, either major or minor, will be completed. When prepare maintenance schedule generally need have significant works to be undertaken the current standards. This work can be required simply because of the age of the machine.

MAINTENANCE SCHEDULE

Perform the PRE-RIDE INSPECTION in the Owner's Manual at each scheduled maintenance period.

I: Inspect and clean, adjust, lubricate or replace if necessary. C: Clean. R: Replace. A: Adjust. L: Lubricate.

The following items require some mechanical knowledge. Certain items (particularly those marked * and **) may require more technical information and tools. Consult your Honda dealer.

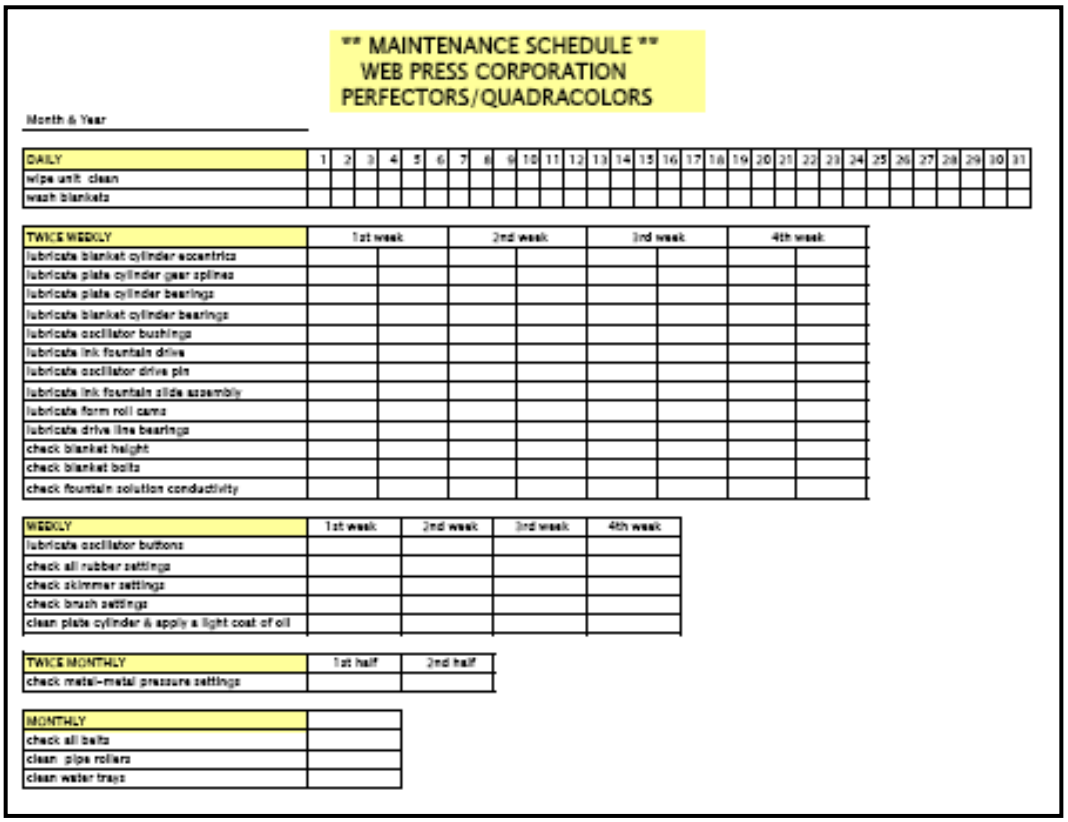
	ITEMS	FREQUENCY NOTE ⇩	ODOMETER READING (NOTE 1) x 1,000 mi	4	8	12	16	20	24	REFER TO PAGE
			x 1,000 km	6.4	12.8	19.2	25.6	32.0	38.4	
EMISSION RELATED ITEMS	* FUEL LINE				I		I		I	3-5
	* THROTTLE OPERATION				I		I		I	3-5
	* AIR CLEANER	NOTE 2				R			R	3-6
	CRANKCASE BREATHER	NOTE 3		C	C	C	C	C	C	3-7
	SPARK PLUG		EVERY 16,000 mi (26,600 km) R							3-8
	* VALVE CLEARANCE	NOTE 4	EVERY 32,000 mi (51,200 km) I							3-9
	ENGINE OIL			R		R		R		3-11
	ENGINE OIL FILTER			R		R		R		3-12
	RADIATOR COOLANT	NOTE 5			I		I		R	3-13
	* COOLING SYSTEM				I		I		I	3-14
	* SECONDARY AIR SUPPLY SYSTEM				I		I		I	3-14
	* EVAPORATIVE EMISSION CONTROL SYSTEM					I			I	3-15
NON-EMISSION RELATED ITEMS	FINAL DRIVE OIL				I		I		R	3-15
	BRAKE FLUID	NOTE 5		I	I	R	I	I	R	3-16
	BRAKE PAD WEAR			I	I	I	I	I	I	3-17
	BRAKE SYSTEM				I		I		I	3-18
	* BRAKE LIGHT SWITCH				I		I		I	3-18
	* HEADLIGHT AIM				I		I		I	3-19
	CLUTCH SYSTEM				I		I		I	3-19
	CLUTCH FLUID	NOTE 5		I	I	R	I	I	R	3-19
	* REVERSE OPERATION				I		I		I	3-20
	SIDE STAND				I		I		I	3-20
	* SUSPENSION				I		I		I	3-21
	* NUTS, BOLTS, FASTENERS				I		I		I	3-21
	** WHEELS/TIRES				I		I		I	3-22
	** STEERING HEAD BEARINGS				I		I		I	3-22

Figure 2.2: Example of maintenance schedule from manual user guide

(Source: rupb.com)

Figure 2.2 is an example of maintenance schedule from manual user guide which the schedule guide the users how to do the maintenance towards the machine or product which can be seen the items in the schedule had been divide into emission items and

non-emission items. The maintenance that that had been done will be recorded in a form by follow the timing of inspection that had been recommended by the product or machine manufacturer by yearly, monthly, weekly, daily and hourly follow the frequency needed.



** MAINTENANCE SCHEDULE **
WEB PRESS CORPORATION
PERFECTORS/QUADRACOLORS

Month & Year

DAILY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
wipe unit clean																															
wash blankets																															

TWICE WEEKLY	1st week		2nd week		3rd week		4th week	
lubricate blanket cylinder eccentrics								
lubricate plate cylinder gear splines								
lubricate plate cylinder bearings								
lubricate blanket cylinder bearings								
lubricate oscillator bushings								
lubricate ink fountain drive								
lubricate oscillator drive pin								
lubricate ink fountain slide assembly								
lubricate form roll cams								
lubricate drive line bearings								
check blanket height								
check blanket bolts								
check fountain solution conductivity								

WEEKLY	1st week	2nd week	3rd week	4th week
lubricate oscillator buttons				
check all rubber settings				
check skimmer settings				
check brush settings				
clean plate cylinder & apply a light coat of oil				

TWICE MONTHLY	1st half	2nd half
check metal-metal pressure settings		

MONTHLY	
check all belts	
clean pipe rollers	
clean water trays	

Figure 2.3: Example of monthly and yearly schedule maintenance
(Source: webpreecorp.com)

Figure 2.3 shows an example of maintenance schedule followed the timing inspection by monthly and yearly. Each components that had been listed in the form will be inspect from time to time by follow the recommendation interval time in order to prevent failure occur towards the product or machine.

2.1.2 Corrective Maintenance

Corrective maintenance should be categorized under proactive maintenance. It simply starts with the discovery of a situation that could harm the plant operations. The primary difference between maintenance and preventive maintenance is that a problem must exist before actions are taken (Higgins, 1995)

Corrective maintenance, unlike breakdown maintenance, is focused on regular, planned tasks that will maintain all critical plant machinery and systems in optimum operating conditions. (Higgins, 1995)

2.1.3 Preventive Maintenance

In (Levitt, 1997), preventive maintenance is a series tasks performed at a frequency dictated by the passage of time, the amount of production, machine hours or condition that either extend the life of equipment or detect that the asset has had critical wear and is going to fail or breakdown.

As per Westerkamp (1997), preventive maintenance is the systematic planning annual scheduling at regular intervals an on-time completion of needed repairing and replacing component to:

i) Minimize operating losses caused by breakdown
ii) Prolong the useful life of capital assets.
iii) Lower overall costs

The objective of preventive maintenance (PM) is to reduce the probability of failure in the time period after maintenance has been applied (Lofsten, 1999). Preventive maintenance has long been recognized as extremely important in the reduction of maintenance costs and improvement of equipment reliability. Two major factors that should control the extent of a preventive program are first, the cost of the program compared with the carefully measured reduction in total repair costs and improved equipment performance; second, the percent utilization of the equipment maintained (Higgins, 1995).