

Computer Supported Equipment Replacement Management

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Abstract –Replacement of equipment is needed when it is not economical to continue further due to increased cost of maintenance, repair cost, operating cost etc. In the current work, software has been developed to computerize the implementation of replacement policy for equipment whose maintenance cost increases with time and not considering money value to determine replacement age and average yearly cost at the time of replacement. It results in minimization of time to manually determine replacement age and consider cases involving fixed, variable and zero resale or scrap value of equipment. The cost of equipment, maintenance cost and scrap value are taken as input parameters for the software to compute optimal replacement age and average yearly cost at the time of replacement.

Keywords- Replacement analysis, optimum replacement age, replacement policy.

I. INTRODUCTION

Replacement analysis is carried out when the need arises to replace the equipment due to reduction in operating efficiency, increase in maintenance and operating cost or due to technological obsolescence [1]. New approach using optimal replacement policy with stochastic maintenance and operation cost is proposed [2]. Optimum replacement strategies are adopted for some of repair replacement models [3]. Optimal maintenance and replacement policy is also introduced for a deteriorating system with increased mean down time [4]. The GUI based software which can access the database of maintenance cost records of various existing machines and their cost and scrap value to automatically compute replacement age is not available.

Software has been developed using Visual Basic and MS Access to computerize the implementation of replacement policy for equipment whose maintenance cost increases with time and not considering money value to determine replacement age and average yearly cost at the time of replacement. The maintenance cost and resale price or scrap value and other pertinent information related to the equipment can be stored in database. This data can be subsequently retrieved during replacement analysis for an existing machine.

It can also perform replacement analysis of new machines by taking the estimated maintenance cost, cost of machine and scrap value to find the optimum replacement age.

II. REPLACEMENT POLICY FOR ITEMS WHOOSE MAINTENANCE COST INCREASES BY NOT COUNTING MONEY VALUE WITH FIXED RESALE VALUE

The startup screen shown in Fig.1 shall be used to implement the replacement policy for items whose maintenance cost increases with time and not counting the money value by clicking on the button. User can apply the

replacement policy for an existing machine by pressing the button in the screen as shown in Fig.2.

It navigates to the next screen as presented in Fig.3 to enable the user to choose one of the three options for feeding resale price or scrap value of the equipment.

S Equipment Replacement Management Software
EQUPMENT REPLACEMENT POLICY
Replacement policy for items whose maintenance cost increases with time & money value not counted
Exit
Fig.1 Replacement policy
🔍 Replacement policy for items whose maintenance cost increases with time & m 📳 🗖 🔀
Replacement age of an existing machine
Main

Fig.2 Screen to select replacement age of n existing machine



Resale price/Scrap value	Main
(* Fixed	
C Vaying	Next >
C Zero	
	< Back

Fig.3 Screen to choose Fixed Resale price / Scrap value

The screen shown in Fig.4 will be displayed in case the user has chosen the fixed resale price. The data such as cost of machine, Resale price or scrap value of machine are retrieved using the machine number from the database.



Fig.4 Replacement policy based on fixed resale price

The user can navigate to the next screen as displayed in Fig.5 to retrieve the maintenance cost data related the selected machine by navigating through data control. The user can press *OK* button to commit the data and enable the *Report* button. Report button can be pressed to see the replacement report shown in Fig.6 presenting optimum replacement age and average yearly cost at the time of replacement for the selected machine.

Maintenance cost entry form e Number M101 100 250 400 600 OK. 900 1250 1600 Cancel 2000 < Back H 4 Maintenance Cost Records > H

Fig.5 Maintenance cost data entry form

III. REPLACEMENT POLICY FOR ITEMS WHOOSE MAINTENANCE COST INCREASES BY NOT COUNTING MONEY VALUE WITH VARYING SCRAP VALUE

The user can select second option in the screen as shown in Fig.7 in case the equipment is having varying resale price. Next button navigates to the screen as displayed in Fig.8. The user has to retrieve the varying scrap and maintenance cost data related to typical equipment from the database for replacement analysis which has already been stored or enter data as shown in Fig.9 and Fig.10.

Replacement policy	Maintenance cost increses with time,fixed Resale Price & money value not counted
Machine number	M101
Name of the manufacturer	Manufacturer - A
Model	M01
Type of machine	Miling M/c
Aptimum replacment time	At the end of 6 year
Average yearly cost at the time of \$ replacement	1563 3333333333
	Main
Average yearly cost at the time of replacement	1561 3333333333 Main

Fig<mark>.6 Re</mark>placement report

Replacement policy for items whose maintenance	e cost increase with time & money value 🗐 🗖 🔀
Resale price/Scrap value	Main
C Fired	
G Vaying	Next >
C Zero	
	(Back



Replacement policy based on varying resa	le price
Machine number	M1201
Name of the machine manufacturer	Manufacturer - 8
Year of make	2008
Model number	M02
Type of machine	Milling Machine 💌
Cost of machine	6000
No.of years of maintenance cost data available	8 💌
< Back OK	Cancel Next>
M 4 Mac	hine Data Records 🕨 📕

Fig.8 Replacement policy based on varying resale price/ scrap value



Report button can be pressed to see the optimum replacement age, average yearly cost at the time of replacement of the equipment selected for analysis is presented in Fig.11.

Scrap value entry	/ form		
Machine Number	M1201	Scrap value	
1	\$	3000	OK
2	\$	1500	
3	\$	750	
4	\$	375	Next >
5	\$	200	
6	\$	200	Cont 1
8	5	200	Lancel
9	\$		
10	\$	·	< Back
	H Sca	ap Data Records 🕨 🕨	



Mainténance cos	t entry form			
Machine Number	M1201	_		
Maintenance cost at the end of the year	Ма	intenanece cost		
1	\$	1000	Report	
2	\$	1200		
3	\$	1400		
4	\$	1800	ОК	
5	\$	2300		
6	\$	2900		
7	\$	3400	Cancel	
8	\$	4000		
9	\$			
10	\$		< Back	h
	H Mai	ntenance Cost Recor	ds 🕨 📕	

Fig.10 Maintenance cost entry form

Replacement Report	
Replacement policy	Maintenance cost increses with time, vaying Resale Price & money value not counted
Machine number	M1201
Name of the manufacturer	Manufacturer - B
Model	M02
Type of machine	Miling Machine
Aptimum replacment time	At the end of 5 year
Average yearly cost at the time of replacement	\$ 2700
	Main

IV. REPLACEMENT POLICY FOR ITEMS WHOOSE MAINTENANCE COST INCREASES BY NOT COUNTING MONEY VALUE WITH ZERO SCRAP VALUE

The user can select third option in the screen as shown in Fig.12 to perform the replacement analysis of the equipment having zero scrap value. Next button navigates to the screen as shown in Fig.13. The user has to retrieve the maintenance cost data related to typical equipment from the database for replacement analysis which has already been stored or enter data as shown in Fig.14. Fig.15 shows the replacement report showing optimum replacement age and average cost of replacement of the typical equipment chosen for replacement analysis.

 Replacement policy for items whose maintenance cost in 	crease with time & money value 📮 🗖 🞽
Retale price/Scrap value	Main
C Fixed	
C Vaying	Next >
6 Zeo	
	(Back

Fig.12 Screen to choose Zero resale price /scrap value

	Replacement policy based on zero resale price
	Machine number M1301
1	Name of the machine manufacturer Manufcaturer - C
4	Year of make 2012 💌
•	Model number M03
	Type of machine MillingMachi 💌
	Cost of machine \$ 9000
	No. of years of maintenance cost data available
1	
	< Back OK Cancel Next >
	Machine Data Records

Fig.13 Replacement policy based on zero resale price/ scrap value

Fig.11 Replacement report



S Maintenance cost	entry form		
Machine Number	M1301	_	
Maintenance cost at the end of the year	Ма	intenanece cost	
1	\$	200	Report
2	\$	2200	
3	\$	4200	
4	\$	6200	OK.
	\$		
	\$		
	\$		Cancel
	\$		
	\$		
	\$		K Back
	H 4 Mai	ntenance Cost Recon	ds 🕨 📕

Fig.14 Maintenance cost entry form

Replacement Report			replacement analys
Replacement policy	Maintenance cost increses with time,fixed Resale Price & money value not counted		[1] S.D.Sharma, O Nath & Co Pu
Machine number	Milaut		238-264.
Name of the manufacturer	Manufcahurer - C		[2] Ye, Meng-Hu stochastic main
Model	M03		Journal of Ope
Type of machine	MillingMachine At the end of 3 year		[3] Stadje, Wolfg strategies for Advances in A
replacment time			[4] Jayabalan, V
Average yearly cost at the time of \$ replacement	5200	R	maintenance an system with Research Logis
	Main		
Fig.1	5 Replacement report		A ophi
V	. RESULTS	n Er	igineering M

Fig.15 Replacement report

V. RESULTS

Replacement age of machine i.e. M101 is computed by retrieving cost of machine, maintenance cost data and fixed resale price as shown in Fig.4 and Fig.5. The optimum replacement age is at the end of 6th year since maintenance cost in 7th year (\$1700) exceeds average yearly cost for 6 years (\$1583.33).

The cost of machine and maintenance cost data for 8 years, varying resale prices of Machine (M1201) are retrieved as shown in Fig.8, Fig.9 and Fig.10 respectively. By clicking the report button, computation is performed to find average cost; and comparison is made between maintenance cost and average cost. The optimum age of replacement of machine M1201 is reported at the end of 5th year as shown in Fig.11 due to maintenance cost in 6th year (\$2800) is more than average cost for 5 years i.e. (\$2700).

The cost of machine and maintenance cost data of machine M1301 are retrieved and optimum replacement age is computed in the similar way by considering zero scrap value and replacement age is found to be at the end of 3 years as reported in Fig.15.

VI. CONCLUSIONS

Equipment replacement software has been developed to computerize the implementation of replacement policy for equipment whose maintenance cost increases with time and not considering money value to determine replacement age and average yearly cost at the time of replacement. It results in the minimization of time to manually determine replacement age for cases involving fixed, variable and zero resale or scrap value of equipment. It enables to retrieve maintenance cost records from database for existing machines to determine optimum replacement age. The estimated maintenance cost shall be entered for a new equipment to determine its replacement age. It helps in taking purchase decisions in short time by performing replacement analysis using the GUI based software.

REFERENCES

- [1] S.D.Sharma, Operations Research, Kedar Nath Ram Nath & Co Publishers, 11th Edition, 1996, Unit 4, pp. 238-264.
- [2] Ye, Meng-Hua. "Optimal replacement policy with stochastic maintenance and operation costs." European Journal of Operational Research 44.1 (1990): 84-94.
- [3] Stadje, Wolfgang, and Dror Zuckerman. "Optimal strategies for some repair replacement models." Advances in Applied Probability 22.3 (1990): 641-656.
- [4] Jayabalan, V., and Dipak Chaudhuri. "Optimal maintenance and replacement policy for a deteriorating system with increased mean downtime." Naval Research Logistics (NRL) 39.1 (1992): 67-78.