International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Replacement of Machines & Equipments before Failure Should be Preferable: A Study

Atul Kumar Sahu[1], Nitin Kumar Sahu[2], Bharti Sahu[3], Anoop Kumar Sahu[4]

[1]Department of Industrial & Production Engineeringm, Guru Ghasidas University, Bilaspur (C.G)-India
atul85sahu@gmail.com

[2]Department of Industrial & Production Engineering, Guru Ghasidas University, Bilaspur (C.G)-India
nitin83sahu@gmail.com

[3]Department of Electronic and Communication, SRIT, Jabalpur, M.P, India-482002
bharti_sahu1@yahoo.com

[4]Department of Mechanical Engg, N.I.T Rourkela, Orissa-769008
anoop17212@gmail.com

Abstract: ***Replacement is a type of maintenance given to a system to run efficiently and effectively .Many researchers have stressed on determining the optimum time of replacement through various models .Replacement theory is normally worried with the problem of replacement of man ,machines, and equipments due to deterioration ,decreased efficiency, failure or break down .Replacement problem has been studied by several researchers and is also an essential theme in operation research and management science .Various authors have considered the framework in the working situation where the degradation or wear of a unit can be measured and have suggested various models for replacement .The work presented here attempts on the importance of replacement and highlights numerous reasons for replacement and defines the necessity of the replacement .***

Keywords: Replacement Reasons, Qualitative Assessment, Maintenance, Constant Usage.

1. Introduction

The major conflict lies in deciding that "Should we replace an asset that we own now or later". This article helps the owners and manufacturer in analyzing and supports them in taking their decision on the area of replacement by exploding the numerous possibilities of taking replacement decision. The main intension of replacement is to decide the Economic life i.e. the period of time in terms of years that yields the minimum equivalent uniform annual cost (EUAC) of owning and operating an asset or equipment .The Replacement Theory is a decision making process of replacing a used equipment with a alternate substitute; mostly by a new equipment of superior practice. The replacement might be necessary due to the deteriorating property or malfunction or breakdown of particular equipment. Replacement Theory is used in many cases such as accessible items have outlived, or it may not be economical any longer to continue with them, or the items might have been ruined their life or destroyed either by accident or else. The life of any operating asset generally follow failure pattern and is represented by bath tub curve. When the failure rate (number of failures per unit time) is plotted against a continuous time scale then the resulting curve is known as bath tub curve which exhibits three zones as shown in **Fig (1)** below [1-5].

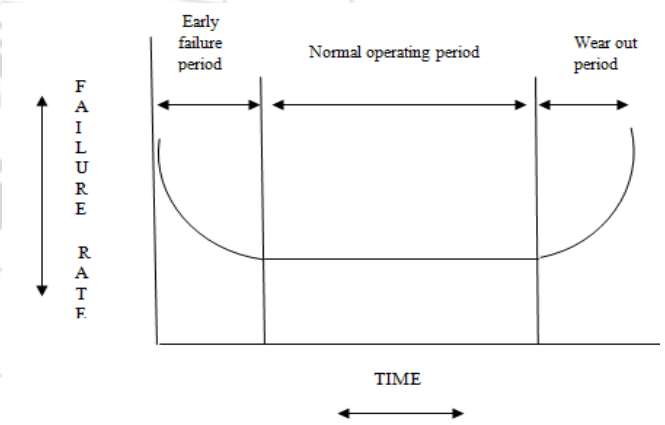

Figure: 1 Bath tub curve

In the third zone the curve represents high maintenance due to abrasion, creep, fatigue, corrosion, vibration etc. after the end of that phase the machinery generally replaces by the owner or manufacturer as it becomes useless as the metal becomes embrittled and the insulation dries out. The work outline here shown that irrespective of the third phase of bath curve there can be the various different possibilities and the unlikely cases which demands the requirement of replacement .the work presented would like to draw the attention of the owner in the field of replacement. The **Fig (2)** presented depicts the differential requirement of the maintenance action between the new and old equipment with respect to time.

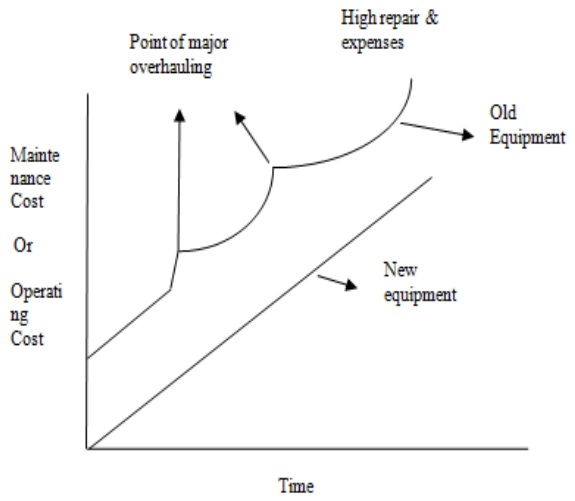

Figure 2: Differential requirement of the maintenance action between the new and old equipment with respect to time

2. Life Cycle Cost

The life cycle cost of the equipment/machines is generally composed of original cost, salvage value, operating costs, maintenance costs, renewal costs, decommissioning costs and is represented by the following function [1-8]:

$$F(x) = P-Q+R+S+T+U$$

Where
F(x) = Life Cycle Cost
P = Original Cost
Q = Salvage Value
R = Operating Costs
S = Maintenance Costs
T =Renewal Costs
U =Decommissioning Costs
When the average life cycle cost of the equipment is minimum, then after the end of that time span the replacement is usually preferable .the life cycle cost of the equipment generally deals with the quantitative assessment and deals with cost optimization. The work presented here shows the requirement of replacement based on qualitative assessment rather than quantitative.

3. Rationale for Favoring Replacement of Assets

Large number of factors is responsible to replace the equipments before its estimated useful life .The various possible reasons which necessitate the replacement of equipment and machines are [8-18]:

- Depreciation of the equipments due to wear and tear
- Increment in maintenance costs, reduction in product quality.
- Decrement in rate of output ,increase in labor costs etc
- Unavailability of spare parts
- Possibility of performing additional operations by new machines
- Obsolescence caused due to technological development
- Profit reduction and competitive strength of the firm to remain rival in the market due to changed machinery
- Change in product design or automation
- Reduction in scrap or spoiled work by new machines.
- Reduced safety as compared to new machines available and developed
- Replacing old machines which creates unpleasant i.e. smoky ,noisy ,pollution and hazardous working conditions causing workers un-safety and leading to accidents
- More reliable machines developed
- Saving resulting from consumption of less power or fuel by the new machine
- High maintenance and repair cost of existing equipments and machines
- Improvement in quality and productivity by the use of new machine
- To reduce down time of existing equipments due to breakdown ,repairs
- Reduction in the cost of jigs, fixtures, special tools etc by the use of new machines.
- Salvage value of new equipment and its useful life
- Lesser space requirement by the new machine

4. Conclusion

Many researchers studied the machine replacement problem which is a significant area in operations research, industrial engineering and management science. Items which are under regular and constant usage experience replacement at an appropriate time due to competence and efficiency of the working system. In the work we highlighted that many people feel that equipment should not be replaced until it is bodily and physically worn out. But, it is not right, operational equipment must be regularly ,persistently and constantly rehabilitated and modernized and updated to remain competitive and to retain efficiency otherwise it will be in the menace of malfunction or it may become obsolete and out dated.

The paper discusses the value and importance of replacement in production atmosphere. The objective of the proposed work focuses on striking a balance between the cost and the competitive environment. The possibilities of equipment replacement are discussed to ensure delivering the normal performance of the equipment. This script also discusses the life cycle and the life cycle cost of the assets. These work discussed with respect to the parameters like maintenance cost, time and obsolescence.

References

[1] S.R. Bowling, M.T. Khasawneh, S. Kaewkuekool, B.R. Cho, ‘’A markovian approach to determining optimum process target levels for a multi-stage serial production system’’, European Journal of Operational Research, (159), pp. 636-650, 2004.
[2] S. Chand, and S.P. Sethi, ‘’Planning horizon procedures for machine replacement models with several possible replacement alternatives’’, Naval Research Logistics Quarterly, (29), pp. 483-493, 1982.
[3] M.S. Fallahnezhad, S.T.A. Niaki, A. Eshragh-Jahromi, ‘’A one-stage two-machines replacement strategy based on the Bayesian inference method’’, Journal of

Industrial and Systems Engineering, (1), pp. 235-250, 2007.
[4] S.T.A. Niaki, M.S. Fallahnezhad, ''A decision making framework in production processes using bayesian inference and stochastic dynamic programming'', Journal of Applied science, (7), pp. 3618-3627, 2007.
[5] E.L. Presman, S.P. Sethi, H. Zhang, A. Bisi ''Average cost optimal policy for a stochastic two-machine flowshop with limited work–in-process'', Journal of Nonlinear Analysis, (47), pp. 5671-5678, 2001.
[6] S.P. Sethi, W. Suo, M.I. Taksar, and Q. Zhang, ''Optimal production planning in a stochastic manufacturing system with long-run average cost'', Journal of Optimization Theory and Applications, (92), pp. 161-188, 1997.
[7] R.B.M. Huirne, T.H.B. Hendriks, A.A. Dijkhuizen, G. Giesen, ''The economic optimisation of sow replacement decisions by stochastic dynamic programming'', Journal of Agricultural Economics, (39), 426-438, 1998.
[8] A.W. Jalvingh, A.A. Dijkhuizen, J.A.M. van Arendonk, E.W. Brascamp, ''An economic comparison of management strategies on reproduction and replacement in sow herds using a dynamic probabilistic model'', Livestock Production Science, (32), pp. 331-350, 1992.
[9] A.R. Kristensen, ''Hierarchic Markov processes and their applications in replacement models'', European Journal of Operational Research, (35), pp. 207–215, 1998.
[10] M.S. Abdel-Hameed, ''Optimal replacement of a system subject to shocks'', Journal of Applied Probability, (23), pp. 107–114, 1986.
[11] H. Makabe, H. Morimura, ''On some preventive maintenance policies'', Journal of Operations Research Society of Japan, (6), pp. 17–47, 1963.
[12] H. Morimura, ''On some preventive maintenance policies for IFR'', Journal of Operations Research Society of Japan, (12), pp. 94–124, 1970.
[13] T. Nakagawa, ''Optimal number of failures before replacement time,'' IEEE Transactions on Reliability R 32, pp. 115–116, 1983.
[14] T. Nakagawa, T.K. Kowada, ''Analysis of a system with minimal repair and its application to replacement policy'', European Journal of Operational Research, (12), pp. 176–182, 1983.
[15] S.H. Sheu, W.S. Grith, T. Nakagawa, ''Extended optimal replacement model with random minimal repair costs'', European Journal of Operational Research, (85), pp. 636–649, 1995.
[16] H.M. Taylor, Optimal replacement under additive damage and other failure models,'' Naval Research Logistics, (22), pp. 1-18, 1975.
[17] C. Tilquin, R. Cleroux, ''Periodic replacement with minimal repair at failure and general cost function'', Journal of Statistical Computing and Simulation, 63-67, 1975.
[18] J. Weissmann, Weissmann, A.J. Gona, S. 2003 ''Computerized equipment replacement methodology'', Journal of the Transportation Research Board, pp. 77-83, 2003.

Author Profile

Atul Kumar Sahu is an assistant professor in the Department of Industrial & Production Engg. Guru Ghasidas Central University, Bilaspur, India. His current area of research aligned operation research and quality management, and scheduling problem of job in machining cell. He has presented a number of papers in various conferences in India.

Nitin Kumar Sahu is an assistant professor in the Department of Industrial & Production Engg, Guru Ghasidas Central University, Bilaspur, India. His current area of research aligned supply chain and production management, and multi-criteria decision-making. He has published a some of journal papers in national/ international repute and presented a number of papers in various conferences in India.

Mrs. Bharti Sahu is the M-tech student of Department of Electronic and Communication SRIT, Jabalpur, M.P, India. She has earned Bachelor of Engg from Bhopal. Recently, she has published few manuscripts in context of management and robots realms on her parent institute.

Mr. Anoop Kumar Sahu is a Research Scholar (Production Specialization) in the Department of Mechanical Engineering, National Institute of Technology, Rourkela, India. He is currently pursuing his PhD. in the area of Supply Chain Management.
.