Short Article
Engineering

Verification of Machinery Salvage Value Function

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ABSTRACT [ENGLISH/ANGLAIS]

Salvage value or resale value is one of the cost components of machinery replacement models. Some replacement models exclude salvage value in the build-up of cost. Yet it is the value that is adversely affected by deterioration. Various mathematical formulas for machinery salvage value have been formulated. The formula for salvage value presented by Lake and Muhlemann is of interest. It is presented in an exponential form. The suitability of this function to our industrial environment has to be justified bearing in mind that some assets have little or no secondhand value. To ensure a balanced investigation, efforts are made to obtain salvage values for motor grader, representing large scale industrial environment and photocopier, representing small and medium scale industrial environment. It is difficult to obtain salvage values because records are hardly kept for such values. However, two sets of salvage values are obtained for each of the machines. One set is for the calibration of the salvage value function by Lake and Muhlemann while the other is for comparison between the measured and predicted salvage values. This paper therefore sets out to investigate and verify the suitability of salvage value function formulated by Lake and Muhlemann to our industrial environment. It is hoped that the investigation will lead to a better understanding of the salvage value function for proper application in our industrial environment.

Keywords: Salvage value, replacement models, verification

RÉSUMÉ [FRANÇAIS/FRENCH]

La valeur de récupération ou de la valeur de revente est l'une des composantes du coûtdes modèles de remplacement des machines. Certains modèles de remplacementd'exclure la valeur de récupération dans l'accumulation de coûts. Pourtant, c'est la valeurqui est affectée par la détérioration. Diverses formules mathématiques pour la valeur de récupération des machines ont été formulées. La formule pour la valeur de récupérationprésentés par Lake et Muhlemann est d'un intérêt. Il est présenté dans une forme exponentielle. La pertinence de cette fonction pour notre environnement industriel doit êtrejustifié portant à l'esprit que certains actifs ont peu ou pas de valeur d'occasion. Afin de garantir une enquête équilibrée, des efforts sont déployés pour obtenir des valeurs de récupération pour les niveleuses, représentant l'environnement industriel à grande échelleet d'un photocopieur, représentant les petites et moyennes environnement à l'échelle industrielle. Il est difficile d'obtenir des valeurs de récupération parce que les dossiers ne sont guère conservés pour de telles valeurs. Cependant, deux ensembles de valeurs de récupération sont obtenus pour chacune des machines. Un ensemble est pour le calibrage de la fonction de valeur de récupération par le lac et les Muhlemann tandis que l'autre est pour la comparaison entre les valeurs de récupération mesurés et prédits. Ce document vise donc à enquêter et de vérifier l'adéquation de la fonction valeur de récupération formulée par Lake et Muhlemann à notre environnement industriel. Il est à espérer que l'enquête va conduire à une meilleure compréhension de la fonction de valeur de récupération pour une application correcte de notre environnement industriel.

Mots-clés: La valeur de récupération, des modèles de remplacement, la vérification.

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Accepted/Accepté: November, 2011

Citation: Ekeocha RJO, Odukwe AO, Agunwamba JC. Verification of Machinery Salvage Value Function. World Journal of Engineering and Pure and Applied Sciences 2011;1(2):88-90.

INTRODUCTION

Salvage value refers to the proceeds from the sale of second hand plant/machine. It depends on the conditions of the plant/machine at the point of sale. Such conditions include deterioration, the service life (man-hour), maintenance history and the capacity of the plant/machine. Records for salvage values of machinery are not easy to achieve when compared to records for the cost prices of similar machinery. Most machinery and equipment are scrapped or cannibalized after their service or economic life especially where an active resale market does not exist. Records are not usually kept for the scrap values and no value is usually placed on the cannibalized parts of such machinery. A way of predicting salvage value for machinery replacement models has to be sought. Various mathematical formulas for machinery salvage value have been presented [1-3]. Lake and Muhlemann [4] formulated a salvage value function that is in exponential form. There is therefore the need to verify the suitability of the function to our

industrial environment since it is one of the cost components in most machinery replacement models. The objective of this paper is to verify the suitability of salvage value function by Lake and Muhlemann [4] to our industrial environment.

METHODOLOGY

The methodology is a combination of analytical and experimental processes. The processes begin with the collection of two sets each of measured (actual) salvage values for CAT 140H Motor Grader and SHARP SF-2035 Photocopier (Field Data) followed by the calibration of the salvage value function using a set of the field data to obtain values for deterioration. The next step is to use the calibrated salvage value function to predict salvage values for the Motor Grader and Photocopier. Another set of field data is then used to plot separate graphs of measured and predicted salvage values of the machines for comparison. Finally the correlation coefficients between the measured and predicted salvage values of the Grader and Photocopier are derived to ascertain the strength and linear dependence of the two variables. The value of the correlation coefficient between the measured and the predicted salvage values gives an indication of the suitability of the salvage value function to our industrial environment.

IMPLEMENTATION

The salvage value function by Lake and Muhlemann [4] is given by

$$S(t) = Q(1-d)^t$$

Where S(t) = Salvage Value
Q = Cost of Machine
d = Deterioration
t = Time (age)

CALIBRATION OF THE FUNCTION

The regression line [5] is given by

$$\log\left[\frac{S(t)}{Q}\right] = t\log(1-d)$$

And the slope of the regression line is given by

$$b = \log(1-d)$$

Table 1: This Table shows variation of salvage value with Age of Motor Grader and Photocopier

t	2	3	4	5	6	7	8	9	10	11	12	13
S(t)g	248500	230000	210000	194000	163500	161000	155250	161000	137500	104500	105000	98500
S(t)p	145000	135000	120000	115000	100000	95000	90000	85000	84000			

S(t)g = Salvage Value of the Grader in Dollars; S(t)p = Salvage Value of the Photocopier in Naira; t = Age in Years

Source: Resale market (Grader), Business centre (Photocopier)[6]

Table 2: This Table shows variation of Measured and Predicted Salvage Values S(t) with Age of Motor Grader and Photocopier

Age t	Measured Salvage Value of the Motor Grader	Predicted Salvage Value of the Motor Grader	Measured Salvage Value of the Photocopier	Predicted Salvage Value of the Photocopier
1			140000	142935
2	264500	258683	130000	136203
3	227750	237396	120000	129788
4	214000	218854	110000	123675
5	184750	201302	100000	117850
6	158750	185157	90000	112299
7	152000	170307	80000	107010
8	147250	156649	75000	101969
9	161000	144086	60000	97167
10	109500	132530		
11	104500	121901		
12	105000	112125		
13	94250	103132		

Applying the least square method on the data in Table 1,
b = - 0.0363 and d = 0.0802 for the Grader
b = -0.02096 and d = 0.0471 for the Photocopier

Q = $305760 for the Grader and N150000 for the Photocopier

Figure 1: This figure shows comparison of the measured and predicted salvage values of grader

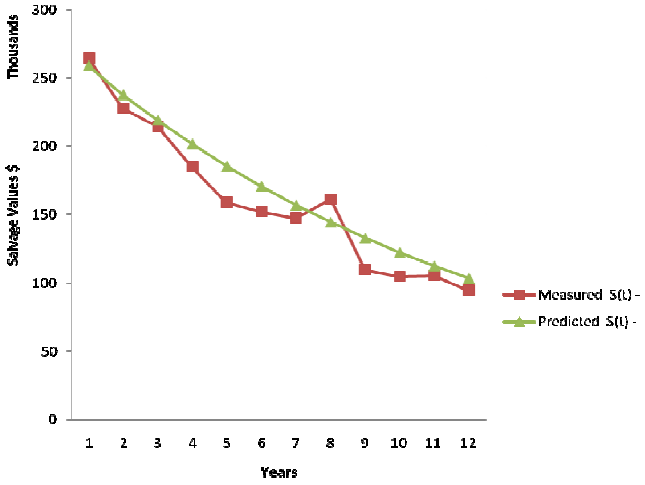
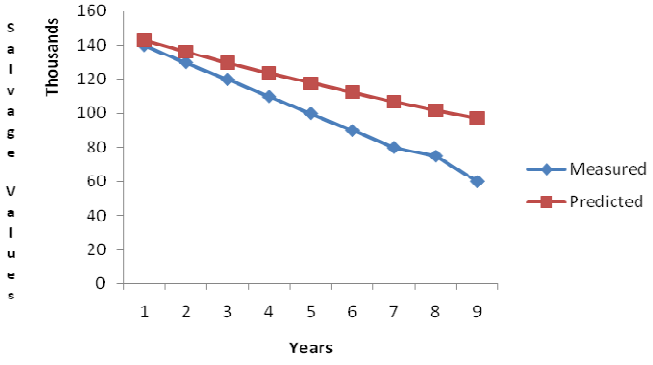


Figure 1: This figure shows comparison of the measured and predicted salvage values of photocopier



DISCUSSION

The measured and predicted salvage values of the Motor Grader are linearly dependent with a correlation coefficient of 0.98 (figure 1). This is an indication of the suitability of the salvage value function by Lake and Muhlemann [4] to the large scale industrial environment. The measured and predicted salvage values of the Photocopier also show a high degree of linear dependence of the two variables with a correlation coefficient of unity (figure 2). This means that the salvage value function by Lake and Muhlemann [4] is very suitable for application in the small and medium scale industrial environment. It is of interest to note that both the Grader and Photocopier have remarkable secondhand value (Tables 1 and 2). The percentage deviation between the measured and predicted salvage values is generally low with absolute values ranging from 2.22 to 17.38% for the Grader and 2.05 to 38.25% for the Photocopier.

CONCLUSION

The measured and predicted salvage values are positively correlated with correlation coefficient of 0.98 for the Grader and unity for the Photocopier. The salvage value function by Lake and Muhlemann [4] is therefore suitable to our industrial environment. The remarkable secondhand value of both machines is worthy of note. The generally low absolute values of the percentage deviation between the measured and predicted salvage values of both the Grader and Photocopier is another indication of the suitability of the salvage value function to our industrial environment.

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ACKNOWLEDGEMENT / SOURCE OF SUPPORT

Nil

CONFLICT OF INTEREST

No conflict of interests was declared by authors.