DETERMINING THE OPTIMUM MOMENT TO REPLACE THE DEPRECIABLE TANGIBLE ASSETS

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Abstract: Promoting the technical progress by developing, modernizing and refitting the existent capacity is a very complex action from the economic point of view, sometimes difficult to accomplish, but that generates some of the best results for the activity of the entity. Determining the optimum moment to replace some pieces of equipment and taking the best decision in buying new equipment play an important role in this activity. Determining the optimum moment to replace the equipment by means of economic calculation of the efficiency has to take into account many factors, of which, most important are the specific conditions in which each asset functions and the influence of the technical progress.

Key words: tangible assets, depreciation, technical progress, breakeven, efficiency.

An important place in the modernizing process is determining the optimum moment to replace the equipment when the existent equipment of the departments, workshops or jobs are no longer justified from the economic point of view. The specialized literature showed many methods that could determine the optimum moment to replace the equipment. One of the most used is the Kaufmann method, it considers the replacement of the equipment needed when the service and functioning expenses exceed the total expenses brought up-to-date. The category of the total expenses includes both the reparation expenses, the service expenses and the functioning expenses and the expenses that are made in order to purchase new equipment.

The formula to calculate the total up-to date expenses is:

$$C_t = \frac{Vi + \sum_{h=1}^{n} R_h \cdot \alpha^{h-1}}{\sum_{h=1}^{n} \alpha^{h-1}}$$

where:

C_t – represents the total up-to date expenses;

Vi –the acquisition value of the equipment;

R_h –the service, reparation and functioning expenses;

α - up –to –date factor, $\alpha = \frac{1}{1+a}$, **a** being the up-to-date coefficient;

n – the number of years used for the calculation.

According to the used method, the equipment is to be replaced in the year h when the condition that the value of the total expenses is less or equal with the value of service, reparation and functioning expenses for the fallowing year (h+1), that is:

$$R_{h+1} \geq \frac{Vi + R_1 \cdot \alpha^0 + R_2 \cdot \alpha^1 + R_3 \cdot \alpha^2 + ... + R_n \cdot \alpha^{n-1}}{\alpha^0 + \alpha^1 + \alpha^2 + ... + \alpha^{n+1}}$$

relation that can also be written:

$$R_{h+1} \geq \frac{Vi + \sum_{h=1}^{n} R_h \cdot \alpha^{h-1}}{\sum_{h=1}^{n} \alpha^{h-1}}$$

This method has the advantage that takes into account the influence of the time factor, the influence of the development of the technical progress on the existent equipment, by means of the coefficient "a".

In order to emphasize the way to put into practice the presented example, we propose the determination of the optimum moment to replace a boring mill AFT 180 PAMA that belongs to S.C. Popeci Heavy Equipment S.A. Craiova, whose acquisition value is 45.310 lei. The medium annual service and repair expenses are shown in **table 1** (column 2), and the medium economic efficiency level in the area the entity evolves is 0.15. Under these conditions the up-to-date factor is determined as follows:

$$\alpha = \frac{1}{1+0,15} = 0,8695652$$

From the estimation it results that the values of the service, reparation and functioning expenses grow progressively, while the total up-to-date expenses decrease progressively, so that at the level of the 17th year of functioning the criteria previously stipulated and the equipment is no longer efficient, its replacement being needed.

Table 1. Determining the efficient functioning duration of the equipment and the optimum replacement moment

- lei -

Year	R_h	α^{h-1}	$R_h \cdot \alpha^{h-1}$	$V_i + \sum_{h=1}^{n} R_h \cdot \alpha^{h-1}$	$\sum_{h=1}^{n} \alpha^{h-1}$	$\frac{Vi + \sum_{h=1}^{n} R_h \cdot \alpha^{h-1}}{\sum_{h=1}^{n} \alpha^{h-1}}$
1	***2***	***3***	***4***	***5***	***6***	***7***
1	424,0	1,000	424,00	45.734,00	1,000	45.734,00
2	508,8	0,870	442,43	46.176,43	1,870	24.693,28
3	610,6	0,756	461,70	46.638,14	2,626	17.759,17
4	732,7	0,658	481,76	47.140,82	3,284	14.356,18
5	879,2	0,572	502,69	47.665,34	3,855	12.363,23
6	1.055,0	0,497	524,52	48.212,67	4,353	11.076,78
7	1.266,0	0,432	547,33	48.783,79	4,785	10.195,33
8	1.519,2	0,376	571,12	49.379,74	5,161	9.568,13
9	1.823,0	0,327	595,94	50.001,59	5,488	9.111,48
10	2.187,6	0,284	621,85	50.650,47	5,772	8.775,17
11	2.625,1	0,247	648,88	51.327,56	6,019	8.527,30
12	3.150,1	0,215	677,09	52.028,49	6,234	8.345,73

Year	R_h	α^{h-1}	$R_h \cdot \alpha^{h-1}$	$V_i + \sum_{h=1}^{n} R_h \cdot \alpha^{h-1}$	$\sum_{h=1}^{n} \alpha^{h-1}$	$\frac{Vi + \sum_{h=1}^{n} R_h \cdot \alpha^{h-1}}{\sum_{h=1}^{n} \alpha^{h-1}}$
1	***2***	***3***	***4***	***5***	***6***	***7***
13	3.750,1	0,187	700,92	52.756,63	6,421	8.216,19
14	4.480,1	0,163	728,14	53.502,86	6,584	8.126,71
15	5.280,1	0,141	746,23	54.302,90	6,725	8.074,89
16	6.510,0	0,123	800,04	55.156,52	6,848	8.054,63
17	7.987,9	0,107	853,63	56.039,89	6,955	8.057,88
18	9.506,1	0,093	883,36	57.027,82	7,048	8.091,81
19	12.226,1	0,081	987,93	57.989,21	7,128	8.134,95
20	13.682,3	0,070	961,39	58.970,10	7,199	8.191,81
21	16.053,8	0,061	980,89	59.955,08	7,260	8.258,54
22	18.538,8	0,053	984,98	59.955,08	7,313	8.198,54

In the economic activity, determining the optimum moment of replacement of a tangible asset generates two facilities:

a. knowing the efficient functioning duration, the entity has the possibility to ensure the investment funds necessary, so that the quash of the tangible asset would coincide with the moment of the retechnologization of the departments and the workshops; elaborating a rigorous program of investments depends mostly of the determination of the optimum moment of replacement.

b. useful information for the managerial activity can be obtained if it is compared the efficient functioning duration of the tangible asset (established based on the calculation regarding the optimum moment of replacement) with the normal depreciation duration. Virtually, there are three situations:

1. $D = D'$
2. $D > D'$
3. $D < D$

Where: D – represents the functioning duration of the tangible asset

D' - represents the rated usage duration of the tangible asset

We appreciate that the first case reflects a neutral situation, though the most important are the other two situations.

The second case shows the fact that we face an accelerated depreciation, which is positive, the economic entity can constitute its investment funds much earlier, which create the perspective of development and modernization of its own activity.

Finally, the third case is the most unfavourable: it reflects the situation when the fixed asset must be put out of duty before being completely depreciated. It is recommended, by all means, to avoid such a situation.

Taking into account the special importance of the determination of the optimum moment of replacement of the tangible assets, it is necessary, when adopting the economic decision, to use other methods able to disclose important aspects for the investment decision. Therefore we present other elements of economic analyses.

In some activity areas, during the years there were purchased equipments and installations with a high mechanic and automation degree and that function independent

of other equipment, as in the case of the installation of the chemical, metallurgical, *chemo fining* industry. Here there can be individualized both the operating expenses and the production value and, based on this, to establish the mathematical functions that approximate the evolution in time of the two indicators, then the moment the two indicators are equal is determined (that is the profit is zero), that being the optimum moment to replace the equipment. The optimum moment to replace the equipment is possible to establish in this way because during the entire existence of a tangible asset or, what we would call physical functioning duration, we can differentiate two important periods. In the first period the expenses necessary for the production with the equipment put to use are under the level of the production (income). It results a profitable activity, materialized in profit. But, as the new improvements in the production process appear at the competitors, a gradual decrease of the production value is noticed.

So, we get to the situation when starting from a certain moment, the production value decreases under the level of the production cost necessary to accomplish that production, like in **figure no. 1.**

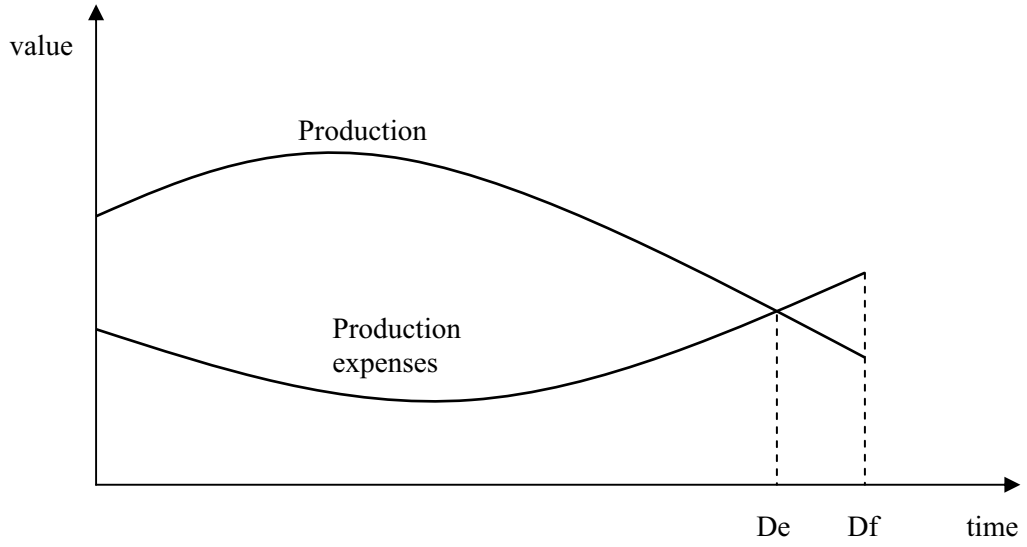

Figure 1. The evolution of production and of the costs in time

Accordingly, the activity that is based on the exploitation of that particular equipment becomes non profitable and it is reflected in losses in the production results so the equipment must be replaced.

In order to apply this method for determining the optimum moment to replace the equipment the fallowing phases should be taken into account:

- identify the evolution of production and of costs during a certain period, 8-10 years;
- establish the mathematical functions the two indicators evolve after in this period;
- the functions coefficients are calculated by means of the already known methods;

- testing the degree the chosen functions approximate the evolution of the indicators;
- in the case they are in good condition, the optimum moment to replace them is established the efficient functioning duration (De), by computing the system formed of the equations of the two functions.

Determining the optimum moment to replace the equipment by means of this method has the advantage that the effects of the moral usage can be avoided and also a comparison can be made between the projected efficiency of the equipment and the effective one in order to adopt the eventual measures. In the case similar equipment exists in that department one can proceed to the extrapolation of the cost evolution and the value of their production, to establish the efficient usage duration (Df), duration that should be written in the documents of the next purchased equipments in the sense of a good fundament of the economic efficiency, especially by using the bringing up-to-date calculations

Likewise, by determining the production evolution and of the costs at a number of 5-6 similar equipments the medium decrease rhythm is determined, respectively the increase rhythm of these two important indicators. Afterwards this rhythm could serve as an entrance date in the efficiency calculations of the next equipment to establish the evolution of production and costs. There may be some objections regarding their use, because from one equipment to another in the project are introduced a series of new parts (mechanizations, automations, technologies etc.) corresponding with the evolution of the technical progress. This is still considered not to impieties applying the presented method because the calculation of the rhythm for more existent equipments leads to obtaining a medium number that afterwards may be modified, more or less, by the delineator, according to the improvements brought to the project of the new equipment.

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