

THE TECHNICAL EFFICIENCY INDICATORS IN THE MANAGEMENT OF THE MAINTENANCE ACTIVITY

ROMOCEA Marius

University of Oradea, Faculty of Electrical Engineering and Information Technology
mromocea@yahoo.com

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Abstract. Considering the complexity and the increased automatization of the equipments, the integration and the constant progress of technologies, the increased reliability of the systems and the higher and higher cost of the investments the discussion is about delimiting the main categories of efficiency indicators of the maintenance indicators. The efficiency indicators of the maintenance indicators are divided in two categories: technical indicators and economic indicators. The paper presents a few of the efficiency of the technical indicators.

1. INTRODUCTION

Industrial maintenance represents an ensemble of measures and actions that allow the prevention, the good maintenance or the re-setting of an equipment in a foreseen state or capable to assure a determined service in the conditions of minimizing the maintenance costs.[1]

The maintenance activity implies the performance of all the operations that contribute to the maintaining the technological and productive state of the installations, machines and equipments, at an efficiency level compatible with the age, in order to ensure the continuity and quality of the production. If the equipment registers in time a decrease of its functioning capacity, through the maintenance and repair activities, we act in the direction of moving it away from the critical state.

Its organization conception regarding the maintenance and repair of the equipments is in a continuous evolution; at present, this activity aims the reduction of the costs at a minimum, with stress on the activity of preventing the damages, because it seems to be more economic to foreseen the damage that to fix it through corrective maintenance activities. The efficiency of the maintenance activity is characterized through technical indicators and economical indicators.

2. TECHNICAL INDICATORS OF THE EFFICIENCY OF THE MAINTENANCE ACTIVITY

The prevention of the premature degradation, the accidental falls and the functioning of the equipments at adequate quality parameters are influenced by the way of organising the technical interventions. The technical indicators of assessing the maintenance activity include: availability indicators, liability and efficiency of the functioning time.

2.1. AVAILABILITY INDICATORS

1) *Average availability (D_M)*. The availability represents the probability that the system be able to function after a time period used for repairworks imposed by the fall that took place after a period of good functioning. From the quality point of view, availability represents the capacity of an equipment to fulfil the function for which it has been conceived. The notion of availability is quantified through the indicator called average availability D_M , defined through the report:

$$D_M = \frac{MTBF}{MTBF + MTTR} \quad (1)$$

where:

MTBF – mean time between failures,
 MTTR – mean time to repair.

The value of the average availability must be as high as possible; it depends on several factors, among which [4]:

a) Constructive perfecting level of the equipment, in view of the reduction of the time necessary to perform various maintenance and repairs operations, so that ARP becomes minimum.

b) The exploitation way. In the case of machine-tools, the exceeding of the splinting speed or the advance speed over the admitted limits leads to the acceleration of the wear process, hence a reduction of the AGFP.

c) The maintenance policy adopted.

d) The tool's age.

2. *Average unavailability (I_M)* – expressed through the report:

$$I_M = \frac{MTTR}{MTBF + MTTR} \quad (2)$$

It represents the reversed size of the average availability. The value of this indicator must be as small as possible.

2.2. RELIABILITY INDICATORS

1) *The tools reliability (F_u)* – represents the ability of a device to fulfil the function specified, in given conditions and along the pre-established conditions. The calculation relationship is the following:

$$F_u = \frac{N_p}{FT} \quad (3)$$

In which:

N_p = the number of incidental defects appeared during the functioning,
 FT = functioning time

Reliability represents the ensemble of the quality characteristics of a technical system which determine its capacity to be used in prescribed conditions for a period as long as possible (maximum AGFP), according to the purpose it has been built for. The value of this indicator must be as high as possible.

2) *Reliability of the technological line L_T* – represents the capacity of the line to fulfil the function for which it has been created in given conditions and for a predetermined period.

This indicator is expressed through the report:

$$F_L = \frac{N_p}{N_u} \quad (4)$$

In which:

N_u = the number of production units from the technologic line.

Reliability, as a measure of probability of good functioning with the prescribed norms, expresses the quality on time, which under certain conditions can be ensured through taking-over the tasks of a tool by a similar one, without interrupting the functioning of the technological line.

2.3. EFFICIENCY INDICATORS OF THE FUNCTIONING TIME

In order to define these indicators we will consider the fact that the total functioning time of the equipment has the following components [4]:

➤ Useful functioning time,

- Time loss due to non quality (scraps, retouches),
- Performance gauge (time loss due to the differences between the functioning nominal parameters and those actually realized),
- The stop time of the equipment due to breakdowns, parts replacement etc.

1. *Gross functioning ratio RBF* – is defined by the report between the gross time and the total functioning time:

$$RBF = \frac{T_{bf}}{T_{tf}} \quad (5)$$

In which:

T_{bf} = gross functioning time

T_{tf} = total functioning time

For the calculation of this indicator it is necessary to determine the gross functioning time by the elimination from the total time of the time losses due to the stop of the equipment during technical stops. If the time losses due to the stops decrease, then the value of T_{gf} gets closer to T_{ft} .

2. *Performance rate RP* – characterizes the efficiency of the use of the machinery at maximum technological parameters, it is determined with the following relation:

$$RP = \frac{T_{nf}}{T_{bf}} \quad (6)$$

In which T_{nf} represents the net functioning time.

The indicator characterizes the effective functioning of the machinery, without taking into consideration the stop time of the equipments subtracted from the gross function rate. The performance gauge is represented by the difference between the gross functioning time and the net one.

3. *Quality rate in functioning RCF* – characterizes the quality of functioning of the tool through reporting the useful functioning time to the net functioning time:

$$RCF = \frac{T_u}{T_{nf}} \quad (7)$$

In which T_u represents the useful functioning time.

The useful functioning time is obtained, as from the net time we deduct the functioning time during which the equipment produces lower quality parts compared to the requirements. The indicator expresses the extent to which the equipment realises products inadequate from the quality point of view.

4. *The synthetic yield rate* – expresses the totality of the influences which act on the total functioning time. The calculus relationship is the following:

$$RRS = \frac{T_u}{T_{tf}} \quad (8)$$

We observe that:

$$RBF \cdot RP \cdot RCF = \frac{T_{bf}}{T_{tf}} \cdot \frac{T_{nf}}{T_{bf}} \cdot \frac{T_u}{T_{nf}} = \frac{T_u}{T_{tf}} = RRS$$

So, between the indicators listed above, there is the relationship:

$$RRS = RBF \cdot RP \cdot RCF \quad (9)$$

The rigorous calculation of such a synthetic indicators is considered a research team activity, which should have at its disposal data regarding the functioning of a certain

equipment for a long period of time. For this reason table 1 shows a few of the possible values of the indicators for various tool categories.

Table 1.[4]

Activity type (indicator)	Manufacture	Assembly	Packaging
RBF	95-98%	95%	90%
RP	54-72%	35-70%	72%
RCF	95%	95%	95%
RRS	51-78%	38-80%	72%

The optimization of the maintenance activity can be realised by obtaining a ratio of the synthetic yield rate RRS as high as possible, which is possible through the reduction of the time categories which contribute to the reduction of the useful function (stop time due to breakdowns, non-quality, performance gauge, etc.)

One can observe that RRS falls under the task of several compartments and services of the enterprise, receiving a global influence similar to the total productive maintenance (TPM). After the research performed, it could be observed that most of the maintenance managers from the Romanian enterprises do not know this indicator and the only elements used are those tied to the various time categories specific to the equipments [4].

3. CONCLUSIONS

The efficiency indicators of the enterprise's activity are inter-conditioned and for this reason the maintenance must find its place through the first level priorities of the economic activity.

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