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WAYS TO REVEAL THE SOURCES OF DECREASE IN EQUIPMENT USE EFFICIENCY

Statement of problem. At present the insufficient attention is given to complex research for the decision of problems of enterprise activity efficiency increase through perfection of equipment condition management techniques. These questions are especially actual for the enterprises of machine-building and metallurgical complexes. As activity of the enterprises of these branches defines rates of scientific and technical progress both in them, and in other branches of a national economy.

And after all formaintenance of stability of production, it is necessary to maintain effectively the equipment and not to suppose situations of occurrence of losses.

Losses — the direct or indirect actions arising in the process of manufacture which involve time or other kinds of expenses, without addition of value to a product.

For minimization of losses industrial and auxiliary processes should be organized in the optimum image, i.e. it is necessary to make a quality product at the minimum expenses and in time demanded by the consumer.

Efficiency of the equipment use — the basic indicator of system directed on manufacture improvement through approach improvement to management of an equipment condition.

It is recommended to begin activity with definition of size of an indicator of efficiency of use of the equipment on carrying out of improvements. This simple indicator does not reflect sources of losses but shows how much effectively or inefficiently the equipment is used. Practice shows that in calculation of the given indicator its value does not exceed 40 — 60 % for discrete manufacture, and 50 — 75 % for automatic manufacture. At the same time at the world leading enterprises these indicators are over 85 % and over 95 % accordingly [1].

Use of the given problem in publications

The given problem was considered in the works of many scientific — economists, such as: Akberdin R. Z, Akberdina R. A, Bazhenov G. E, Vladzievskij A. P., Vlasov B. V, Ivut R. B., Kolegaev R. M, Kennedy R, Matstsa L, Fedina S. J., Burashnikov A. J., Pshennikov V. V., OrlovA. П., Petukhov R. M., Jakobas V. A., Yakobson M. O., Jakovlev A. I., etc.

In the works of Kennedy R, Matstsa L, the correct organization of the control system of equipment condition is considered as the basic component of the effectively functioning enterprise [2].

For the achievement of the maximum level of efficiency it is necessary to rebuild the standard way of the equipment work organization. Fedina S. J., Burashnikov A. J. focus their attention on it, they say that the best control system of an equipment condition "…is the system of constant action intended for work quality measurement and acceptance of measures to perfect the processes. It is directed on the maintenance of the continuous production quality improvement, the condition of the equipment and personnel development" [3]. Pshennikov V. V in his articles defines that the purpose of equipment condition management is a creation of the enterprise which constantly aims at maximum limiting and complex increase of production system efficiency. The means of achievement of the purpose is the creation of the mechanism which, covering directly workplaces is focused on prevention of all kinds of losses ("zero of accidents", "zero of breakages", "zero of defects") throughout all life cycle of industrial system. For purpose achievement all divisions are used: design, commercial, administrative, but, first of all, industrial [1].

The control system of service and equipment repair is one of the most difficult areas of a control system of manufacture. Maintenance service throughout long time was considered as the minor function demanding expenses. It was traditionally connected with elimination of malfunctions and repair of the equipment subject to deterioration and ageing. However nowadays it becomes obvious that efficient control maintenance service and repair is an important factor in increase of enterprise competitiveness. The control system of service and equipment repair is directed on equipment maintenance in an efficient condition and prevention of its unexpected exit out of operation [4]. Maintenance service can't simply accompany the manufacture, it is its integral requirement. Its connection with the level of equipment use efficiency is a question of the common strategy at the top management level.

Purpose of article — to analyze the possible reasons of equipment use efficiency reduction.

Statement of the basic material.

Necessity to maintenance the stability of manufacture and decrease in losses at every possible

failures at the expense of perfection of system of maintenance service of the equipment was and remains one of the actual problems at the industrial enterprises of Ukraine.

Usually equipment use efficiency is identified with productivity, namely quantity of products which can be made a unit of equipment for a certaintime interval. But productivity does not show quantity of qualitative details in total made and what is more, does not show the effectiveness of the equipment use efficiency.

While measuring the equipment use efficiency it is necessary to consider the indicators: productivity and readiness of the equipment, quality of the products manufactured and the cost price formed by equipment operation. As a result, it is generally possible to present the equipment use efficiency as the following:

$$E = f(R,P,Q,C) \qquad (1)$$

Where E — efficiency of use of the equipment;

R — an indicator of readiness of the equipment to output;

P — an indicator of productivity of output;

Q — an indicator of quality of let out production;

C — an indicator of the cost price of production generated under the influence of operation of the equipment.

The conceptual model of the equipment use efficiency indicator is presented in fig. 1.

Let's consider the components:

Indicator of the equipment productivity — the comparative characteristic showing a proportion of actual productivity of the equipment to planned productivity of the equipment.

Productivity of the equipment — an indicator which is as the relation of the manufactured products quantity to a time interval demanded for its release (fig. 2).

In general productivity can be presented as:

$$П = \frac{Q}{t_q} \qquad (2)$$

Where Q — quantity of manufactured products;

t_q — Time, demanded for release of K production piece.

Theoretical level of output productivity:

$$П = \frac{1}{t_o + t_{s.e.} + t_p} \qquad (3)$$

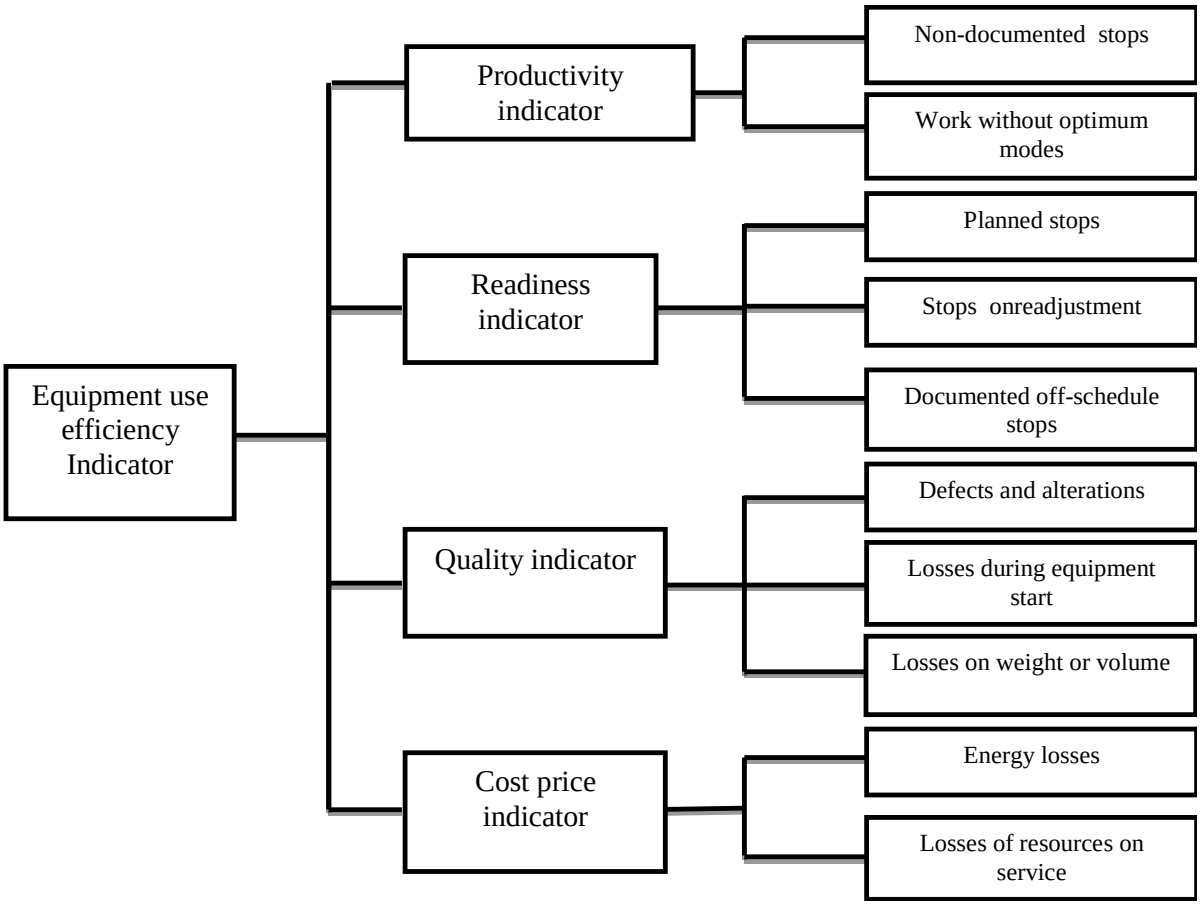

Fig. 1. Conceptual model of the equipment use efficiency indicator

t_o — The operational time demanded for manufacturing of one piece of production;

$t_{s.e.}$ — Downtime of the equipment, necessary for service of the equipment;

t_p — The auxiliary time demanded for manufacture of one piece of production;

Indicator of equipment readiness — an indicator comparing time of the products manufacturing and nominal time of products output.

$$R = \frac{t_{pr} - t_d}{t_{pr}} \quad (4)$$

Where t_d — general time of downtimes;

t_{pr} — Necessary industrial time.

$$t_d = t_s + t_{ns} + t_a \quad (5)$$

t_s — Time of the planned stops;

t_{ns} — Time of not planned stops;

t_a — Time of starting-up and adjustment works;

Indicator of manufactured products quality — the comparative characteristic showing proportion of qualitative products quantity to the total quantity of the manufactured products.

$$Q = \frac{Q_f}{Q_p} \quad (6)$$

Where Q_f — Quantity of qualitative products;

Q_p — Total quantity of of the manufactured products.

Indicator of the cost price of production generated under the influence of equipment operation — a comparative characteristic showing proportion of the actual cost price to the planned cost price.

$$C = \frac{C_f}{C_p} \quad (7)$$

Where C_f — The actual cost price of the manufactured products, generated by work of the equipment;

C_p — The planned cost price of products generated by work of the equipment.

The reasons of equipment readiness indicator reduction:

Breakages of machine tools and mechanisms reduce readiness of the equipment. Breakages — one of the most frequent causes of equipment failures. The equipment

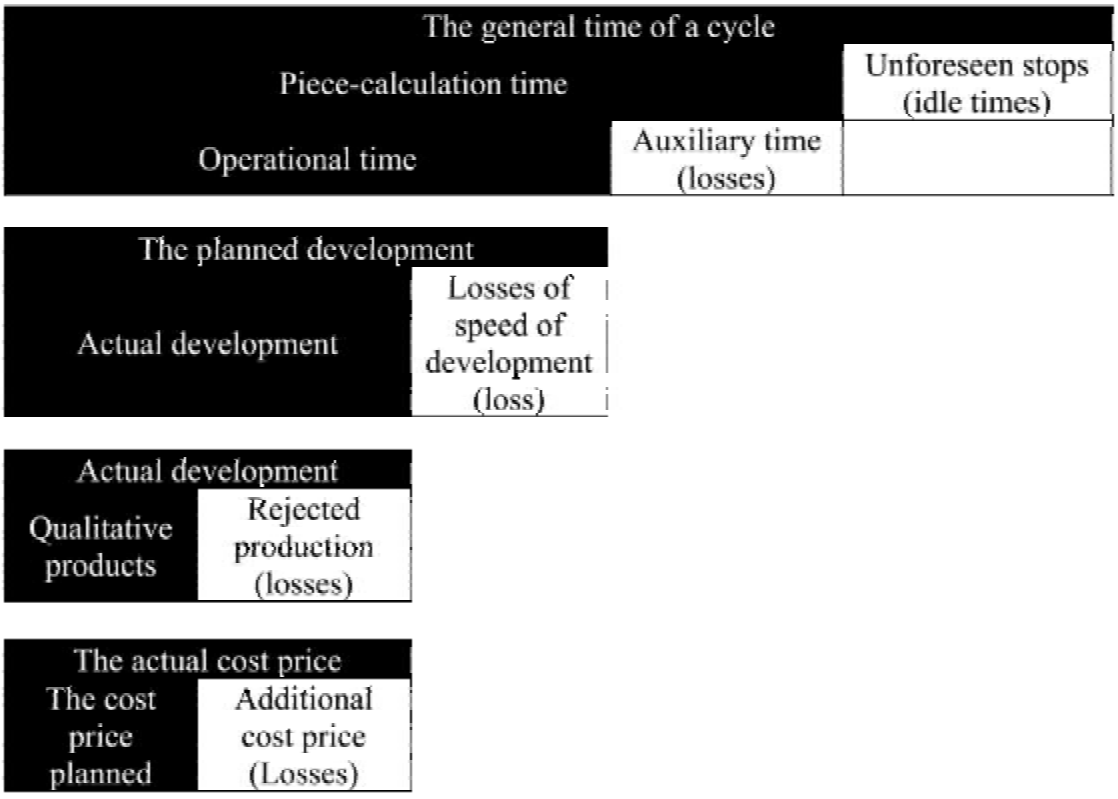

Fig. 2. Graphic representation of equipment use efficiency indicators

consists of a considerable quantity of knots and mechanisms which can fail, than will put out of action all equipment. But it is necessary to remember that signs of that the equipment can fail, appear long before equipment failure;

Readjustment. The component of the readjustment process: dismantle/installation of equipment, clearing of elements of the equipment, adjustment and check of functioning of the equipment etc., including time for search of tools and adaptations;

Replacement of the cutting tools. Replacement of the tool, which lost the working properties leads to not planned stops of the equipment, i.e. to idle times;

Losses at equipment start. Include expenses of time for initial start-up of the equipment till the moment of quality output;

Stops of the equipment which are not provided by the industrial schedule.Time of carrying out of meetings, time of repair work, time of unforeseen breaks here enter.

The account of equipment stop duration in such cases helps to develop the way, allowing to eliminate losses and simultaneously to carry out corresponding actions.

The reasons of productivity indicator decrease:

Violation of processing speed — the equipment works not on optimum modes. Decrease in modes of processing reduces quantity of the made units of production. And overestimate — to premature refusals of the equipment and as consequence holding time increase;

Short-term stop of the equipment — equipment downtime caused by infringement of electric energy supply, pressure of pneumo- or hydro systems. They can last even some seconds once and be insignificant. But it is necessary to measure them as it leads to losses of productivity and decrease of products output volume.

The reasons of decrease in indicator of manufactured products quality:

Alteration and defects. One of widespread versions of losses are defects of quality. Defects can be amendable and un amendable. In case of amendable defect it is necessary to alter a product and the losses increase a hundred percent;

Losses at equipment start. Many kinds of equipment need certain time for entering into a normal operating mode. The start of not properly adjusted machine tools leads to the defects, that is why operators should establish the necessary modes.

The reasons of cost price indicator decrease:

Energy losses. These losses can arise because of uncontrollable deterioration of working elements of the equipment, and not only material, but also moral. I.e. refusal of power saving up technologies use reduces efficiency of use of the equipment. Cost of energy sources is a considerable part of the general production costs, so decrease in actual use of energy will lead to increase. Losses of different kinds of energy or energy sources, for example, electric energy, fuel, steam, hot air or water are united. As the cost of electric energy, fuel and other kinds of energy carriers makes a considerable part of the general costs, the companies are interested in reduction of energy losses. Idle use of energy reduces the equipment use efficiency;

Losses of resources on service. Non-correct organization of maintenance service, non-perfect methods of service, non-sufficient qualification or low level of personnel motivation are sources of the given kinds of losses. Both too frequent and rare repairs, not on an equipment condition, but under the schedule, cause additional expenses of time and finance. That raises the cost price of the manufactured products because of additional spare parts, materials use and increase of service work labor content.

On the basis of the stated above it is possible to make the following **conclusions**:

1) To increase the degree of available equipment use efficiency it is necessary to reduce all kinds of losses.

2) The offered conceptual model will help to analyze the reasons of decrease in equipment efficiency indicator.

3) Use of optimal equipment management system allows to raise equipment use efficiency and reduce all possible losses.

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Momot A. I., Samoilov P. I. Ways to Reveal the Sources of Decrease in Equipment Use Efficiency

The conceptual sample piece of efficiency index of equipment use the which reflects possibility of work complex assessment of the equipment at which such indexes of use as, readiness, capacity, exhausted articles quality, the cost price are considered is offered. The possible reasons of efficiency index abbreviation of equipment use the are considered. Possible aspects of losses which arise at equipment maintenance are considered. Indexes of equipment use efficiency are graphically presented.

Key words: efficiency, equipment use, efficiency indexes, loss, conceptual sample piece,estimation.

Момот А. І., Самойлов П. І. Шляхи виявлення джерел зниження ефективності використання обладнання

У статті запропановано концептуальну модель показника ефективності використання обладнання, яка відбиває можливість комплексної оцінки роботи обладнання, коли враховано такі показники використання, як готовність, продуктивність, якість виробів, що випускаються, собівартість. Розглянуто можливі причини скорочення показника ефективності використання обладнання, можливі види втрат, які виникають під час експлуатації обладнання. Графічно представлено показники ефективності використання обладнання.

Ключові слова: ефективність, використання обладнання, показники ефективності, втрати, концептуальна модель, оцінка.

Момот А. И., Самойлов П. И. Пути выявления источников снижения эффективности использования оборудования

В статье предложена концептуальная модель показателя эффективности использования оборудования, которая отражает возможность комплексной оценки работы оборудования, при которой учитываются такие показатели использования, как готовность, производительность, качество выпускаемых изделий, себестоимость. Рассмотрены возможные причины сокращения показателя эффективности использования оборудования, рассмотрены возможные виды потерь, которые возникают при эксплуатации оборудования. Графически представлены показатели эффективности использования оборудования.

Ключевые слова: эффективность, использование оборудования, показатели эффективности, потери, концептуальная модель, оценка.

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