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# Management Accounting of Production Overheads by Groups of Equipment

Sokolov A. Y.[1] & Sungatullina L. B.[1]

[1] Kazan Federal University, Institute of Management, Economics and Finance, Kazan, 420008, Russia

Correspondence: Sokolov A. Y., Kazan Federal University, Institute of Management, Economics and Finance, Kazan, 420008, Russia. Tel: 7-917-399-2244. E-mail: Sokolov-kzn@bk.ru

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**Abstract**

The paper discusses the current trend of managerial accounting development – accounting of production overheads in industrial enterprises by groups of equipment. The definition of work center or group of equipment is given, the technique for determining the unit indirect costs is suggested. The recommendations can help determine more accurately the cost of the product, calculate the non-financial measurement, plan the work of management, engineering, service and production departments, exercise tight control of costs.

**Keywords:** overheads, costs, cost center, management accounting, analysis, costing, cost estimation, cost reduction

## 1. Introduction

Cost information is generated and submitted to executives until the management decision is made (information support of the decision), and after the decision was taken (outcome measurement of the decision made). The effectiveness of managers' operation depends largely on how costs and results are accounted, planned and analyzed. Nowadays, there is also a need to integrate elements of different methods of generating costs and benefits information of economic entities (ABC, TD-ABC, lean accounting, JIT accounting, etc.) in order to solve the strategic and mid-term goals.

Overhead costs or expenses in production servicing, management and marketing, can, by calculation or through the cost objects, be absorbed by responsibility centers or specific products without forming a real foundation of the latter. Work centers in industrial enterprises are increasingly becoming groups of equipment. This can be automated product lines when parts processing operations are carried out on several machines or multifunction production equipment that allows all operations for processing the workpiece on one machine. Using the multifunction equipment in the contemporary economy is intended to solve a number of problems. Firstly, it is the problem of production under conditions of demand and supply fluctuations. As it is known, it is unprofitable to start production lines for manufacturing small volumes of products. Secondly, it is the problem of reducing the processing time of product parts.

Thus, the work center (WC) may be a group of equipment involved in the production process continuously since the start of processing of a product on the first machine (input) and till the end of processing on the last one (output). If processing the product is interrupted, for example, on the 6th machine (out of 14), and then after operation in another department it returns to the $6^{th}$ machine, it is necessary to identify two work centers, the first of which includes six machines, and the second - eight. Each work center must be encoded (code division, group of equipment). Work centers can be major (the equipment on which the product is made directly) and support (machines which serve the production process: pumps, valves, benches, etc.). Such division affects the whole scheme of costs allocation in the organization and enables to determine product cost more accurately.

## 2. Method

The aim of the study is to explore options for accounting overheads in industrial plants. Problems of overheads accounting are studied in researches by Datar S., Kekre S., Mukhopadyay T., Svaan E. (1991), Kulikova L. I. (2015), Maiga A. S., Jacobs F. A. (2007), Peden A., Baker J. J. (2002), Savory P. (2010), Tang S., Gao Y., Qian F., Wang D. (2013), Zheng Y., Chen M., Yao X., Zhang J. (2010).

Types of equipment vary in cost of purchasing and, consequently, the value of depreciation costs, maintenance costs and the cost of parts processing. This fact should be taken into account in calculating overheads allocation.

Utility costs for production equipment, depreciation costs and the costs of repair and maintenance of equipment can be distributed in proportion to the machine hours in the total sum. It is advisable to select a separate group of overheads accounted for by unused and underutilized manufacturing equipment (Figure 1).

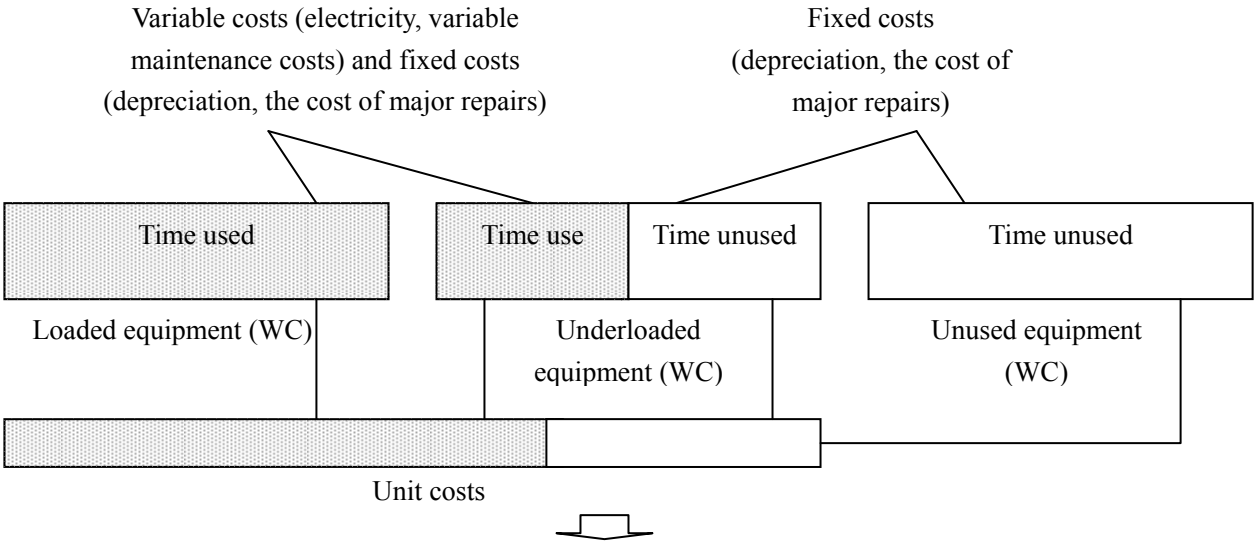


Figure 1. Cost accounting attributable to loaded, underloaded and unused machines

It is advisable to calculate the standard value of production defining its variable and constant component within the group of equipment and separate distribution of fixed costs which are accounted for by the used and unused time between products.

**3. Result**

We will consider the case when the main group of equipment is not fully loaded (or partially loaded), variable and fixed production overheads are correlated to the products manufactured in proportion to the time of equipment operation, which is divided into loaded, partially loaded and unloaded. The formula for determining the production overhead costs takes the following form:

$$o_p = \frac{O_{p1}}{T_p} \times t_p + \frac{O_{p2}}{MT_p} \times t_p + \left[ \frac{O_{p2} - \left( \frac{O_{p2}}{MT_p} \times t_p \times q_p \right)}{T_p} \times t_p \right] +$$

$$+ \frac{O_{p3} + O_{p4} + O_{p5}}{\sum TMT_p} \times t_p + \left[ \frac{\left( O_{p3} + O_{p4} + O_{p5} \right) - \left( \frac{O_{p3} + O_{p4} + O_{p5}}{\sum TMT_p} \times \sum TT_p \right)}{\sum TT_p} \times t_p \right], \quad (1)$$

where $o_p$ - standard overheads per unit of product manufactured in the WC (equipment group), monetary units;

$O_{p1}$ - standard variable overhead costs (including electricity costs, maintenance costs) of the main group of equipment (per month), monetary units;

$O_{p2}$ - standard fixed overhead costs (including depreciation and the cost of major repairs) of the main group of equipment (per month), monetary units;

$O_{p3}$ - standard operating costs for the maintenance of support equipment (the cost of tools and devices, depreciation of support equipment and vehicles, etc.) (per month), monetary units;

$O_{p4}$ -standard operating costs (costs of major repairs, depreciation) attributable to unused equipment (per month), monetary units;

$O_{p5}$ - standard costs of production management (labor costs), depreciation of buildings, etc. (per month), monetary units;

$T_p$ - regular working time fund (machine load taking into account the production volume planned) in this main work center (per month), in machine hours. It is defined as the product of standard time by unit of product ($t_p$) and the planned production volume of these items;

$MT_p$ - regular working time fund (maximum potential machine load) in the main group of equipment (per month), in hours. It is defined as the product of maximum operating time (for example, 8 hours per day) by the number of working days, taking into account the shift-working (number of shifts);

$\sum TMT_p$ - the sum of regular working time fund (maximum potential machine load) in all major groups of equipment or WC at the production department (per month), in hours;

$\sum TT_p$ - the sum of regular working time fund (machine load taking into account the production volume planned) in all major groups of equipment or work centers at the department (per month), in hours;

$t_p$ - standard time per unit of product (parts) in this group of equipment or WC, machine-hours per unit;

$q_p$ - standard output of products in the given group of equipment, units.

As a result, the following costs are formed: the cost of time used in a working center (WC); the cost of unused time within the WC; the used capacity cost (cost of maintaining support equipment and other costs of division or department attributable to the time used); the costs of unused capacity: the cost of maintaining support equipment and other expenses of production department attributable to the time not used. Meanwhile, fixed costs of unused time is a reserve to reduce costs (action – to load machines in full and this group of costs will tend to zero).

We will assume that there are five working centers (WC) or groups of equipment in the division, three of which are not fully loaded (WC1, WC2, WC3), the fourth is loaded fully (WC4), the fifth is not intended to be used in this period (WC5). Product (or part of the product) A is manufactured in WC1. Production operating costs of WC1 amounted to 16,000 monetary units. Of these, variable costs (electricity costs and maintenance costs which may be used depending on the use intensity of the machine) amounted to 7,200 monetary units ($O_{p1}$). Standard working time fund of equipment of WC1 (maximum potential machine load) - 1,600 hours ($MT_p$), standard working time fund of equipment of WC1 (machine load taking into account the production volume planned) amounted to 960 hours ($T_p$), standard manufacturing time per unit of product in WC - 0.4 hours ($t_p$), hence the planned production volume of products - 2,400 (960: 0.4). Standard operating costs are indirect in relation to the WC1: the cost of maintaining support equipment - 6000 monetary units; ($O_{p3}$) (maintains all operating work centers), production costs attributable to unused equipment (WC5) - 3000 monetary units ($O_{p4}$), general shop expenses - 18,000 monetary units ($O_{p5}$).

The total potential maximum loading of all five WC (it should be remembered that WC5is not used) - 9000 hours ($\sum TMT_p$), the total loading of the machines with the total planned production of all five WC is 5400 hours.

As the maximum potential loading of WC1 does not coincide with the loading of WC1 which is calculated taking into account the planned volume of production, the calculation of production overhead costs per unit of WC1 will be as follows:

$$o_p = \frac{7200}{960}\times 0{,}4 + \frac{8800}{1600}\times 0{,}4 + \left[\frac{8800 - \left(\frac{8800}{1600}\times 0{,}4\times 2400\right)}{960}\times 0{,}4\right] +$$

$$+\frac{6000+3000+18000}{9000}\times 0{,}4 + \left[\frac{(6000+3000+18000) - \left(\frac{6000+3000+18000}{9000}\times 5400\right)}{5400}\times 0{,}4\right] =$$

3,0 + 2,2* + 1,47 + 1,2 + 0,8 = 8,67 monetary units per unit

These fixed costs are the cost of time *used*. The same calculation of the distribution of fixed costs can be performed in another way: to determine the percentage of machine load - 60% (960 hours: 1600 hrs.), to determine gross fixed costs of capacity used - 5280 monetary units (8800 monetary units× 60%: 100), to determine the fixed costs per 1 hour of capacity used - 5.5 monetary units per hour. (5280 monetary units: 960 hrs.) and to determine the fixed costs attributable to the capacities used per unit of output 2.2 monetary units (5.5 den. U × 0,4 hour per unit of product).

The greater is the percentage of equipment underloading, the greater is the costs value attributable to inderloaded equipment and, consequently, the cost of production.

If the cost of maintaining support equipment can be divided into variable and fixed, the share of these costs in total manufacturing overhead costs is significant and support equipment serves the main groups of equipment in the shop, then the earlier presented scheme of costs distribution can become complicated. To find a variable and constant component, the methods of correlation analysis can be used.

Let us consider the merits of the option presented. Firstly, the reserves of costs reduction are designated. In our example, this value is 2.27 monetary units (1.47 + 0.8) or 26,2% (2,27: 8,67 × 100%) of the total manufacturing overhead costs per unit of product. In other words, if to load the idle capacity of equipment group to the maximum, then the cost of production will decrease. Since all calculations are carried out prior to the beginning of the reporting period (month), it is possible to make changes in the distribution of orders across the enterprise, determining what machines will make which products. Secondly, cost of production is more accurately determined. If it is necessary, one can also use coefficients which take into account the complexity of the work on different groups of machines and thus to improve the calculations accuracy of the products costs. Thirdly, the presented calculation scheme of standard overheads enable to determine the variable overhead costs of production in a particular WC (equipment group), as well as variable overhead costs attributable to one machine hour operation of this equipment. In our example, the value of these costs amounted to 3 monetary units per unit of product or 7.5 monetary units per 1 machine-hour. If it is technically possible, the first thing should be to load the least cost intensive equipment (the criterion is variable maintenance costs).

As standard overhead costs, you can use the actual costs of the previous period, adjusted by the amount of costs to be reduced. The principle of continuous cost reduction should be applied. In our opinion, to distribute the constant part of costs, analytical rate discussed previously can be used.

However, due to objective circumstances (demand or other reasons) it is not always possible to load the available capacity to the maximum. In such cases it is advisable to determine the actual maximum potential machine load. The formula for determining the cost of the product under consideration takes the following form:

$$o_p = \frac{O_{p1}}{T_p} \times t_p + \frac{\frac{T_p}{MT_p} \times t_p \times O_{p2}}{T_p} + \frac{\frac{MT_{pr} - T_p}{MT_p} \times t_p \times O_{p2}}{T_p} + \frac{\frac{MT_p - MT_{pr}}{MT_p} \times t_p \times O_{p2}}{T_p} +$$

$$+ \frac{\frac{\sum TT_p}{\sum TMT_p} \times t_p \times \left(O_{p3} + O_{p4} + O_{p5}\right)}{\sum TT_p} + \frac{\frac{\sum TMT_{pr} - \sum TT_p}{\sum TMT_p} \times t_p \times \left(O_{p3} + O_{p4} + O_{p5}\right)}{\sum TT_p} + \tag{2}$$

$$+ \frac{\frac{\sum TMT_p - \sum TMT_{pr}}{\sum TMT_p} \times t_p \times \left(O_{p3} + O_{p4} + O_{p5}\right)}{\sum TT_p},$$

where $MT_{pr}$ - standard working time fund (the actual maximum potential machine load) in this main WC (per month) in hours;

$\sum TMT_{pr}$ - the sum of standard working time fund (the actual maximum potential machine load) in all major WC in the division (per month) in hours.

Let us suppose the actual maximum potential machine load of WC was 1560 hours. Total real potential maximum machine load of all five WC is 8100 hours. Let us calculate the standard overheads per unit in the WC1:

$$o_p = \frac{7200}{960} \times 0{,}4 + \frac{\frac{960}{1600} \times 0{,}4 \times 8800}{960} + \frac{\frac{1560-960}{1600} \times 0{,}4 \times 8800}{960} + \frac{\frac{1600-1560}{1600} \times 0{,}4 \times 8800}{960}$$

$$+ \frac{\frac{5400}{9000} \times 0{,}4 \times (6000+3000+18000)}{5400} + \frac{\frac{8100-5400}{9000} \times 0{,}4 \times (6000+3000+18000)}{5400} +$$

$$+ \frac{\frac{9000-8100}{9000} \times 0{,}4 \times (6000+3000+18000)}{5400} = 3{,}0 + 2{,}2 + 1{,}38 + 0{,}09 + 1{,}2 + 0{,}6 + 0{,}2 = 8{,}67 \text{ monetary units per unit}$$

Consequently, the head of the cost center will be responsible for the reduction of unit costs (finding ways to increase machine load) in the amount of 1.98 monetary units (0,6 + 1,38) or 22,8% (1,98: 8,67 × 100%). It should be noted that the special control (detailed cost calculation, deviations, etc.) is given to that group of products which generates a profit target (to do this, Pareto analysis should be carried out).

## 4. Conclusion

Thus, the main objectives of management accountants who organizes management accounting of costs in the context of the WC are determining activities whose costs are to be analyzed for their optimization, choosing the option for specified allowances, generation of analytical information about the standard and actual costs in the context of the WC (including determination of specific quantities of costs attributable to unused capacity), variance analysis of costs in the process of determining the standard costs; deviations of actual costs from target (standard) values using production volume indexes which are universal for the production of several types, participation together with engineers (process engineers, mechanical engineers, etc.) in the development of an optimal program for loading WC which allows to reduce the costs of non-financial accounting measurement (loss, output, product quality indicators, the percentage of machine load, the production cycle, etc.).

The approach presented in the article allows to create scenarios of supposed changes in the structure of output and sales of products (for example, the increase in the production of one product at the expense of another in order to minimize the funds involved in the turnover while increasing profits).

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