COMPARISON OF THE CLASSICAL AND MODERN CALCULATION METHODS AND THEIR USE IN METALLURGICAL ENTERPRISE

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Abstract

The contribution deals with the classical specification of phase calculations in a metallurgical company and compares them with modern calculation methods. It briefly describes the methodology of these calculations, its advantages and deficiencies. This contribution aims to compare these calculations and the possibility of their application and use in a metallurgical enterprise.

Keywords: Methods, calculation, costs, drivers

1. INTRODUCTION

The management accounting theory defines calculations from several points of view. First of all, it is the exact meaningful translation of the word "calculus", which means mathematical analyses or calculations, i.e. the calculating activity. The calculation procedure which determines the costs of an order, for instance. Another meaning of this term is the result of calculation - the actual allocation of different types of costs per performance unit. The last conception of the word "calculation" points to the importance of this activity and describes it as a tool for value cost management. Based on the above conceptual levels, we can also derive the aim of calculations in an enterprise. The purpose of calculations is usually an efficient use of costs in an enterprise and an increase in profitability and value of the enterprise. Each enterprise strives to use such calculation methods to determine the calculations as to be able to quantify the changes in production volume and other important changes affecting the business processes.

2. SPECIFICS OF METALLURGICAL FOUNDRIES

Foundries in metallurgical enterprises are highly specific due to their differentiated production processes. The starting process is usually a molten metal melting plant which is supplemented with secondary metallurgy units for its refining. This is followed by casting of molten metal - into moulds (production of casts), into ingot moulds (production of ingots) or continuous casting (production of semi-finished products for subsequent rolling). Many of the products are repeatedly processed in thermal or annealing furnaces - stabilizing and removing the internal stress in casts, heating of forgings during the forging process etc. Most final products are further processed by machining of various strenuousness - cutting, roughing, precision machining or grinding and polishing with very precise machine parts. [1]

The selection of the most appropriate calculation method is often a long-term process. It depends on the type of production, its continuity, the links among the individual production processes, the type of allocation base, the cost structure and the like.

2.1. Classic calculation methods in metallurgical foundries

In the manufacturing process in metallurgical foundries, there may be different types of step calculations applied in practice. Everything is mostly dependent on the size of the enterprise and the technology which it is operating alone and which it is managing in cooperation, on the variedness of the production process and, last but not least, on the performance dosing management and other aspects which have already been mentioned above. The most problematic part is usually the establishment of an appropriate allocation base.

The first type of calculation is ***gradual method of step calculation***, which is in metallurgical enterprises often referred to as „phase calculation" where each production stage is considered as a separate item of calculation. It calculates all the costs of the semi-finished product being created, including all the overhead costs allocated according to the selected base, usually by the surcharge method, as if it were a final product, which it can actually be in some cases. The calculation of one production stage determined in the above way is the starting point for the next stage. This method is mainly used when the production stages are technologically and organizationally separated and the semi-finished product is used in the next production stage, or it is the final product already. This procedure can be seen in **Figure 1** and **Table 1**.

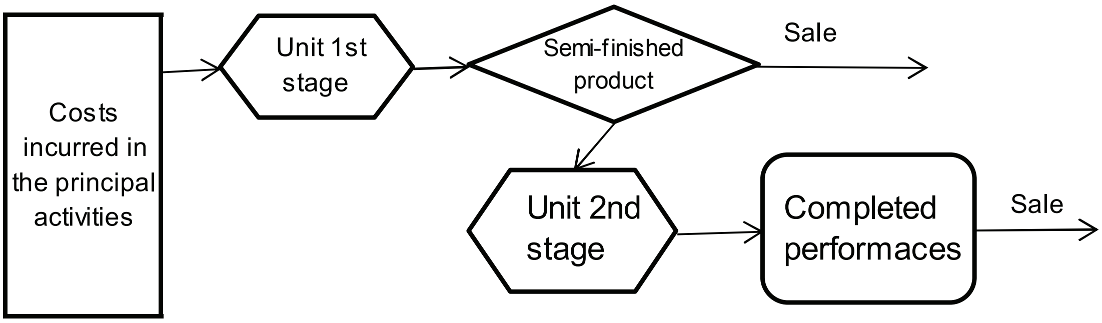

Figure 1 Gradual step calculation

Prerequisites for the use of the gradual step calculation:

- Technologically separated production stages
- Organizationally separated production stages
- In the final of each production stage there is a semi-finished product which can be a final product itself

Table 1 Gradual step calculation in a metallurgical foundry

Calculation items	Production level (CZK)			Total CZK
	I.	II.	III.	
Produced (t)	1 100	1 000	800	
∑ costs of previous stage		**45 450**	**63 160**	
Direct material	20 000	15 000	10 000	45 000
Direct wages	3 500	3 500	3 500	10 500
Other direct costs	8 000	4 000	7 500	19 500
∑ direct costs	**31 500**	**22 500**	**21 000**	**75 000**
Cooperation		1 000	1 000	2 000
Production overheads	12 000	10 000	7 000	29 000
Distribution overheads, administrative costs			5 000	5 000
Total costs	**43 500**	**78 950**	**97 160**	
Returned (t)	1 000	800		
Full own costs (Kč/t)	45.45	78.95	121.45	
Cost of products handed over	45 450	63 160		

The sales and distribution overheads are not calculated until the last production stage. If products were sold in the I. and II. stage as well, the distribution overheads would be calculated for those products as well.

The second method of ***step calculation*** is the so-called continuous calculation which, however, is not usually used in metallurgical plants. It can be used in varied production conditions. The subject of this calculation is not the performance but the individual stages of production process. Direct and indirect production costs are monitored separately for each production stage. The sales and distribution overheads are added to the total costs. At each individual stage, a simple calculation method is applied, and thus the cost of an individual semi-finished product is quantified. Each stage has to be calculated separately, as each stage can contain a different number of operations. The cost of the final product is given by the sum of the constituent costs from each individual stage. [2] This method is applied in varied production processes with a different number of production stages or levels. As can be seen from **Figure 2**, the individual operations pass the semi-finished product on up to its final form.

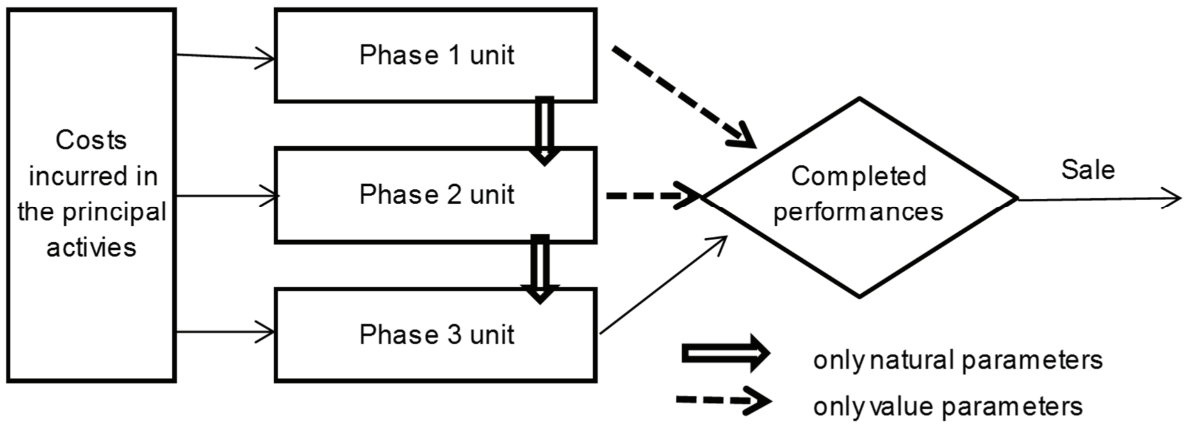

Figure 2 Continuous step calculation

This calculation method, unlike the first type of calculation, can be used in plants that have a completely different way of cooperation among the departments, different technological parameters and therefore a different allocation base as well. At each individual stage, a simple calculation method is used and thus the cost of the calculated semi-finished products is determined. The cost of the final product is given by the sum of the constituent costs from each stage.

For the following sample of continuous calculation, production overheads were used as a traditional allocation base, although they are no longer used nowadays. The following formula was applied to this allocation:

$$K_{VR} = VR/ PM_z \quad (1)$$

K_{VR} - coefficient of production overheads

VR - total production overheads

PM_z - total direct wages

The coefficient of production overheads according to the above formula is 2.32 which is the starting point for the calculation of the production overheads at the individual production stages.

$$\textit{Production overheads of an individual production stage} = K_{VR} \times PM_{(I\text{-}III)} \quad (2)$$

The calculated production overheads of an individual production stage are added to the calculation table and form an item of the production overheads of the relevant production stage - see **Table 2**.

Table 2 Continuous step calculation for a metallurgical foundry

Calculation items	Production level (CZK)			Production process in total	
	I.	II.	III.	Kč	%
Direct material	60 000		10 000	70 000	45.31
Direct wages	5 000	3 500	4 000	12 500	8.09
Other direct costs	8 000	4 000	7 500	19 500	12.62
∑ direct costs	**73 000**	**7 500**	**21 500**	**102 000**	
Cooperation			2 000	2 000	1.29
Production overheads	11 600	8 120	9 280	29 000	18.77
Distribution overheads, administrative costs			5 000	5 000	3.24
Total	**84 600**	**15 620**	**37 780**	**138 000**	**89.32**
Produced (t)	1 150	1 150	1 150	1 150	
Full own costs (Kč/t)	**73.56**	**13.58**	**32.85**	**120.00**	

2.2. Shortcomings of the classic calculation methods in metallurgical foundries

The basic shortcoming of the above calculation methods primarily results from the nature and method of cost calculation.

In case that a larger volume of overhead activates is required in the context of production, the allocation is often burdened with an erroneous value of the overhead costs and the outputs get distorted.

In practice, the actual costs can be adversely affected due to an inappropriately selected allocation base which may consequently lead to overestimation of the costs in large-scale production or underestimation of the costs in custom manufacturing or highly specialized production. [3] All this results from the effect of overheads.

There are also external influences that are specific for metallurgical enterprises which have negative effects on phase or gradual step calculations. They are, for example, the uncertainty of heat treatment where it is often impossible to accurately forecast how many times the specific part will have to be heated. Also the pressure on the efficient use of energy of melting sets plays an important role in the calculation of energies which enter the direct costs. From the operational and economic points of view, it is most advantageous to keep the melting sets running continuously with fixed periodic shutdowns, since most energy and costs is drained in repeated start-ups. However, this is not always allowed by the situation on the market with metallurgical commodities and by the order schedule of the enterprise. The calculation is closely related to a careful plan which is, however, dependent on the variedness of orders.

2.3. Modern calculation methods

The basic requirement behind the inception of modern calculation methods was the allocation of costs to operations according to the actual cost drivers. Finding these casual relationships across the entire enterprise is the underlying principle of a modern calculation method based on activities - Activity Based Costing (ABC). This method of allocating costs to objects uses measurements of real physical performances of individual activities and operations performed. Practice shows that this is the only possible way to eliminate cost generalization in different volume variants of their allocation. [4] The ABC calculation primarily serves to calculate the costs of an expense item, but thanks to its specific position, it is an important tool for cost optimizing and managing.

The activities specified within the ABC calculation are the basic elements of the whole system and the correct definition thereof is a prerequisite for applying this method. The ABC method results in a process concept across the entire enterprise. The combination of a process approach and a cost approach to the enterprise is characteristic for the ABC calculation. For both points of view, an ACTIVITY is the central linking element. This point of view is highlighted in **Figure 3**.

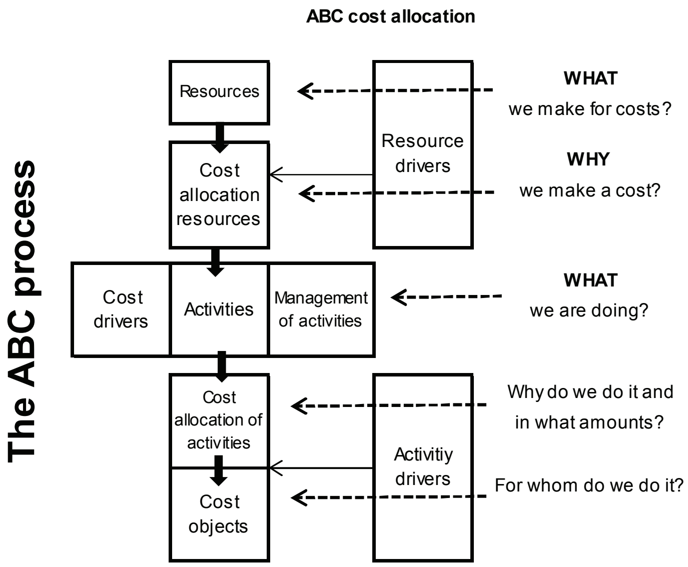

Figure 3 Activity-Based Costing in terms of costs and processes [5]

The actual implementation of the ABC calculation is a longer-term and complex process that includes, first of all, a cost classification, basic categories of activities, a hierarchy of activities, it identifies relationship variables, activity performance levels and, last but not least, the entire structure of the ABC system. The simplified procedure when applying the ABC calculation consists of the following 3 steps:

1) Indirect costs are allocated to individual specified activities according to Resource Cost Driver which determines the method of converting the accounting costs into defined activities.
2) In the second step, the total cost of each activity is determined, its Activity Cost Driver is defined and the unit cost is determined.
3) In the third step, the costs of an expense item (operation, service, customer) are determined, based on the costs per activity unit and the volume of these units which are consumed by the expense item.

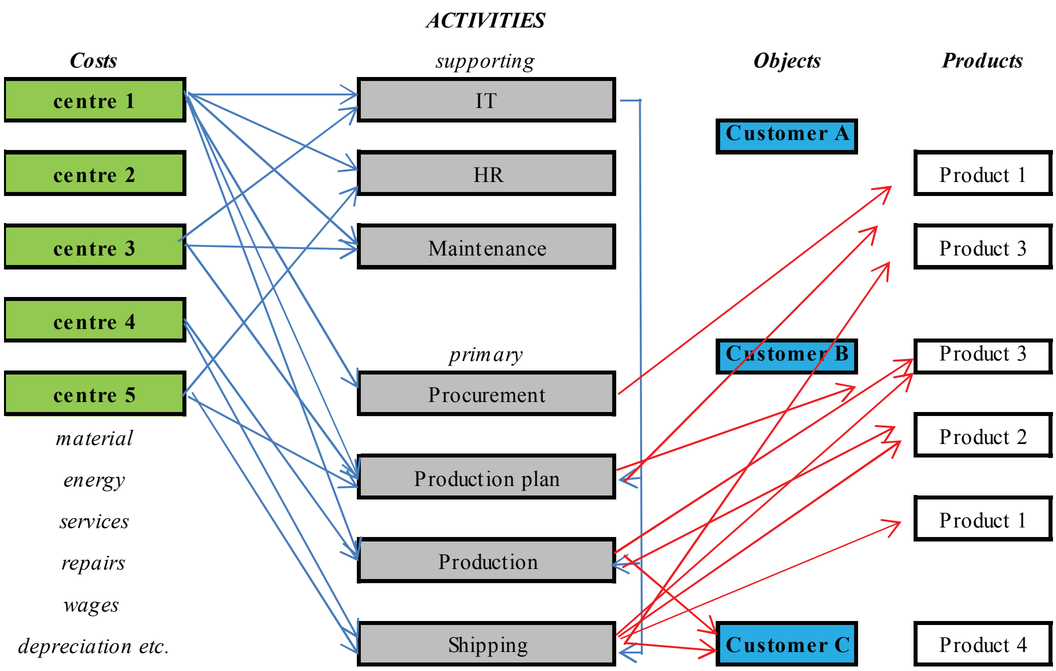

Figure 4 Cost flow in the ABC system

An example of the cost flow in the ABC system is shown in **Figure 4**. The original sketch by the author of Modern Cost Management Methods, Popesko [4], has been adapted for one of the cost flow models in a metallurgical enterprise.

2.4. Advantages and disadvantages of the ABC calculation method

Although the ABC calculation appears to be clearly beneficial, there are drawbacks in its implementation playing a significant role. The principal question is whether and how we can define the calculation unit. **Table 3** provides an overview of advantages and disadvantages, or rather obstacles, when building an ABC system. The source of information is an unnamed foundry, although other types of enterprises in this field may operate and apply completely different calculation methods and procedures.

Table 3 Comparison of the consequences of the ABC system

Advantages	Obstacles
More accurate cost identification, especially overhead costs	Change of thinking towards modern concept of process management
Allocation of costs according to causality principles	Staffing for the implementation of ABC
Reduction in inefficient activities	Choosing the right form of ABC
Identification of the optimum process dose - melting furnace, moudling, heat treatment etc.	The need for an accurate overview of the company's activities
Definition of the effective number of operations per product heating cycle	Management support
Maximum capacity utilization of technology	Cost allocation common to multiple activities
Elimination of undesirable costs of individual processes	Larger volume of default data entering the ABC system
Rapid response to variations and changes in individual processes	

3. CONCLUSION

Given the limited scope of the contribution, it was impossible to apply the ABC calculation method in practice and thus highlight its benefit to a metallurgical foundry as well as its separate processes as outlined above. Nevertheless, it is clear that the dynamics and accuracy of the ABC calculation bring benefits in the first place and help reveal the actual cost drivers, thereby ensuring an effective management of all company costs. Managerial decisions made on the basis of this information can serve as a tool for increasing performance and profitability of the enterprise.

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