

COSTING AS A SIGNIFICANT FACTOR OF THE COMPETITIVENESS OF FOUNDRY COMPANIES

Petr BALON, Jana BUCHTOVÁ

*VSB - Technical University of Ostrava, Ostrava, Czech Republic, EU, petr.balon.st@vsb.cz,
jana.buchtova@vsb.cz*

Abstract

This paper summarizes the results of a case study concerning cost management that took place in the chosen foundry. This study focuses on the comparison between the theoretical costing model and its practical applications. Costing represents an instrument used to determine the consumed costs for the creation of specific outputs of a company and then for determining their prices. It is clear that it significantly affects the competitiveness of the company. It is important to know the foundry process, which is copied by costing, for relevant determination of the costs of production and prices of final foundry output. The aim of this paper is to characterize the problematic areas in the process of costing of the chosen foundry and to provide possible solutions to improve this process. The instrument used to achieve the intended aim is the analysis of the typical costing model of the specific foundry (divided into four basic phases - the calculation of core production, the calculation of liquid metal, the calculation of casting production and the price calculation), which basically represents the absorption costing.

Keywords: foundry, costing model, variable costs, fixed costs, overhead costs.

1. INTRODUCTION

The competitiveness of enterprises depends on the sale of their outputs. The ability of an enterprise to sell its outputs depends on their usable value and the price which the consumer is willing to pay. Costing is a tool used to determine costs and final price of outputs. Real costing can be looked at in several ways. It is understood as an activity in which costs of the defined unit of output - so called costing unit, are determined, or more precisely, found out. The other meaning of costing can be understood as a result of calculating activity, a part of the enterprise information system dealing with recording of costs or a business unit of large enterprises dealing with the process of calculation. External and internal outputs of the enterprise represent the object of costing. In practice, not a single, specific calculation is implemented, but several types of interdependent calculations are involved. This situation can be described in terms of costing system, whose main objective is to establish a task for enterprise or its departments. This defined task has to be improved and its fulfillment has to be evaluated. Basically, costing system is composed of two basic types of calculation - preliminary calculations (rough, operational and plan calculations), which are compiled before actual production process or another business process, and resulting calculations, which are compiled after the completion of a specific enterprise output. The procedure that serves for preliminary determining of the amount of costs or for subsequent establishment of real costs of the specific business output is commonly called the costing method. Costing methods are divided according to the way of costs allocation per costing unit. In practice, there is another crucial tool, so called costing model, which represents the structure used to find out the consumed costs for realization of enterprise outputs. The submitted paper deals with analysis of the costing model of the chosen foundry.

2. COSTING OF FOUNDRY COMPANIES

Costing, also called cost accounting, is the methodology for classifying, recording and allocating the appropriate expenditure incurred for the determination of the cost of construction, production or service performed [1]. If we want to deal with costing of a foundry, it is very important to know its production process. This process is then copied by costing. The foundry production process can be defined as a transformation process with its inputs (i.e. the factors of production obtained from the markets of production factors - raw materials, machinery, people etc.) and outputs (i.e. the outputs of transformation process which are supplied by foundry to the sales markets - castings, or within the foundry - molten metal, foundry cores etc.). During the foundry transformation process, the inputs are transformed into outputs. This process is differentiated from many aspects which determine the production structure of the enterprise and its costing system. The foundry production process can be characterized according to its nature of technology, type of production process, organizational structure of production process, continuity of technological process, segmentation and repetition of production. As far as the nature of foundry technology is concerned, the foundry transformation process could be seen as a mechanical - chemical process, as there is a change of substance within the production of the molten metal. In terms of production process, the foundry transformation process can be defined as a procedural manufacturing as it is characterized by successive processes of transformation of raw materials into the final product. This characteristic is reflected by the organizational structure of the production process, whose realization is based on the knowledge of product and its production amount. This knowledge allows taking decisions regarding the arrangement and control of material and semi-finished products and also the layout of machinery, equipment and workshops. There is no single definite determination concerning the foundry production process; in most case, however, it can be characterized as a phase production. Continuity of the technological process is the next important characteristic in terms of costing. The foundry production process could be described as a discontinuous transition process involving a wide range of non-technological processes and characterized by its segmentation. It is generally composed of several separated processes - production of the molten metal, production of the foundry cores or production of the moulds. There are various types of production within foundry industry - piece production, lot production and mass production. Segmentation and continuity of the production have an impact on the process of costing as well. In practice, the above mentioned means that the foundry is divided into several centres which are focused on specific type of activities to achieve the final product - the casting.

2.1 The typical costing model of foundry companies

The structure used to determine and find out the costs of enterprise outputs is called the costing model. The costing model, which has several forms in practice, is compiled of the individual costing items concerning the specific output. Over time, the typical costing model was developed as the result of pressure on uniform procedure of displaying costs in all industries in the former Czechoslovakia. The form of the typical costing model has been extended and still serves as the basis for the compilation of various forms of costing models for specific industries and companies. In the foundry practice, the structure of costing items is determined by the above mentioned structure of casting production. What is more, the costing models of foundries are different from each other depending on the size and productive orientation of foundries. In the following part of this article, the specifics of calculations of foundries will be demonstrated by displaying the costing model which was taken over with the approval from a concrete foundry enterprise. This costing model can be described as a typical costing model of medium - mechanized foundries of iron castings. This model is divided into four relatively separated phases that are displayed in the **Table 1**.

Table 1 The typical costing model of chosen foundry [2]

ZERO PHASE	$MUCc + DLc + (OUCc) + POCC = FOCC = TPc$ [CZK/dm³]
	MUCc (Material Unit Costs of Core) DLc (Direct Labour of Core Maker) OUCc (Other Unit Costs of Core Shop) POCc (Production Overhead Costs of Core Shop) FOCc (Full Own Costs of Core Shop) TPc (Transfer Price of Core)
I. PHASE	$CM + TF + DLm + (OUCm) + POCm = FOCm = TPm$ [CZK/kg]
	CM (Charging Material) TF (Technological Fuel) DLm (Direct Labour of Melter) OUCm (Other Unit Costs of Melting Shop) POCm (Production Overhead Costs of Melting Shop) FOCm (Full Own Costs of Melting Shop) TPm (Transfer Price of Molten Metal)
II. PHASE	$TPc + TPm - RM + DLca + POCca + AEca = FOCca$ [CZK/kg of casting]
	TPc (Transfer Price of Core spent on a piece of casting (at the level of costs)) TPm (Transfer Price of Molten Metal spent on a piece of casting (at the level of costs)) RM (Return Material spent on a piece of casting (at the level of costs)) DLca (Direct Labour (except DLc and DLm) spent on concrete casting) POCca (Production Overhead Costs spent on production of a piece of casting) AEca (Administrative Expenses spent on production of a piece of casting) FOCca (Full Own Costs spent on production of a piece of casting)
III. PHASE	$Pc = FOCca + P$ [CZK/kg of casting]
	Pc (Price of Casting) FOCca (Full Own Costs spent on production of a piece of casting) P (Profit determined as a result of the multiplication of the coefficient of profit and full own costs of casting)

The zero phase of the costing model represents the calculation of the costs spent on core production. The reason why this phase is designated as the zero phase is connected with the nature of the application of foundry cores during the production of castings - foundry cores are used only in case a cavity is created in a casting or for the creation of the complex shape of its walls. This form of calculation can be described as appropriate because it considers both the different material and the different kind of technology of core production. In this case the transfer price (TPc) of a specific core equals to the full own costs of core shop (FOCc) consumed for its production. FOCc are made up of direct material (in the valuation of current prices), which is used for the core production. Direct labor of a core maker (DLc) consumed for core production is usually determined by piecework wages set by labor norm in the foundry company. Other unit costs of core shop (OUCc) basically represent a voluntary cost item that can be used by foundry for example for calculating the depreciations of core shop machinery. The last significant cost item in this part of the costing model is represented by production overhead costs of core shop (POCc). This item normally includes the indirect wage of the master of the core shop, temporary wages of general workers, overhead material depending on the technology of core production (binders, dye etc.). The costing of the production of molten metal (the first phase of costing model) is the most important phase of costing of foundry enterprises because molten metal represents the biggest cost burden of the casting production. It is very important to focus on the prices of raw materials as well as the cost efficiency of melting technology during the process of calculation of the molten metal (especially in terms of the type of energy used for melting - it is well-known that there is a difference in cost efficiency of the melting process for instance between the gas rotary furnace and the electric induction furnace). Using for example two melting aggregates of the same technology but with different capacity parameters would also not cause their merging in terms of calculation of the molten metal. The full own costs

of the melting shop (FOCm = TPm), i.e. the cost necessary for the production of the molten metal, are composed of costs of charging material (CM) - pig irons, cast iron scrap, steel scrap or additives improving the quality of the produced molten metal. A significant item of costing of the molten metal is the technological fuel (TF) divided according to technology of the melting aggregates (electricity, coke, natural gas). The next costing item is the direct labor of the melter (DLm) which represents the piecework wage set by the labor norm. Other unit costs of melting shop (OUCm) basically again represent a voluntary cost item that can be used by the foundry for example for calculating the depreciations of the melting aggregates or other melting shop machinery. The production overhead costs of melting shop (POCm) are also part of the calculation of costs consumed for the production of molten metal. This costing item includes for example the indirect wage of the metallurgist, rent for the natural gas and liquid oxygen storage facility in case the foundry uses gas rotary furnaces etc. The costing of costs spent on casting production (the second phase of the costing model) includes the results of the previous two phases together with other cost items caused by foundry production process. The costing item TPc represents the transfer price of core at the level of full own costs spent on core production and the costing item TPm represents the transfer price of the molten metal at the level of full own costs spent on production of the molten metal. The item of direct labour required for casting production (DLca) is calculated in this phase. This costing item represents the sum of direct labors of the foundry, except for the direct labors of core maker and melter (they are part of TPc and TPm). The production overhead costs spent on production of one piece of casting (POCca) basically represent the production overhead costs which are defined as a result of company rate of production overhead costs of the relevant enterprise unit and direct labors. Similarly, the item of the administrative expenses spent on production of one piece of casting (AEca) represents the administrative expenses as a result of company rate of the administrative expenses and direct labors. The return material (RM) cannot be ignored in calculating the costs of production of castings. It is usually defined as the difference between gross and net weight of the casting valued by transfer price (at the level of costs) and it is deducted from the above defined items. The final phase of costing in a foundry enterprise is setting the price of castings. The easiest way to setting the price of castings is the sum of the costs of casting production (FOCca) and the required profit (P).

2.2 Practical deficiencies of the typical costing model of foundry companies

The foundry enterprises which use this type of costing are among economic subjects using the full costing or also called absorption costing. It is so named because all manufacturing costs are charged to, or absorbed by, the product [3]. The disadvantage is that this approach does not take into account the different nature of the fixed and variable costs. Variable costs are those costs that change in total as the level of activity changes. By contrast, fixed costs do not change in total with changes in the level of activity [4]. In this case the fixed costs are allocated to outputs according to the basis of burden rate. Although the absorption costing cannot be used to solve all the decision-making tasks in the company, it can be applied for example for long-term cost analysis of produced outputs, price fixing of individually manufactured orders etc. Generally, it can be said that the above mentioned typical costing model of the foundry represents a minimalist form of costing, which can, in extreme cases, cause problems in determining the final price of castings. Therefore, it might happen that the foundry is not able to distinguish whether the production of specific castings will be beneficial or not on the basis of preliminary calculations. The executed analysis revealed that the major problem lies in a significant simplification of the determination of overhead costs of the foundry. This fact applies for production overhead costs (POCca) and administrative expenses (AEca) spent on production of a piece of casting. There is a space for hiding some of the major cost items in the overhead costs of the foundry. In practice, this could lead to underestimation or overestimation of the costs of the production of specific castings, which also leads to underestimation or overestimation of the prices of these castings. Due to this lack of transparency, the specific foundry can become expensive in its production and lose prospective contracts in the cost-overvalued production. This effect may also work the other way round when the cost-undervalued production artificially cheapens the production of the foundry. The foundry becomes cheaper in competition, but this can happen

thanks to orders on which the foundry can lose profit without knowing about it in advance. The above described fact was detected in a specific foundry company, but this situation can arise in the costing of similar types of foundries - medium mechanized foundry of cast iron castings. The solution to this situation may lie in detailed differentiation of the cost items of the foundry - i.e. determine the largest volume of costs as the unit costs and divide the overhead costs into variable and fixed costs. The proposed changes must be supported through a strict separation of the foundry into specific profit or, mostly, cost centers. This requirement would result in an increased claim on the creation of labor norms, monitoring and recording of costs in the foundry. The effort to ensure the competitiveness of enterprises leads to modification of the absorption costing which results in the creation of other costing techniques. These procedures respect, in particular, the different relation of the fixed and variable costs to changes in the production volume. The calculation of incomplete costs (so called variable costing) eliminates the gaps resulting from the absorption costing. What is typical of this method is that it attaches only the variable costs to the outputs of company - hence the title of variable costs. The calculation respects exactly the different relation of the fixed and variable costs to changes in the production volume, which meets the new requirements [5]. The general costing model can take the form given in **Table 2**.

Table 2 Costing model of incomplete costs [5]

MARKET PRICE	
- direct material	} VARIABLE COSTS
- direct labour	
- other unit costs	
- the variable part of overheads relating to the product	
= ASSISTANCE TOWARDS THE COST PER PERIOD	

The assistance towards the cost represents fixed costs together with profit in a separate calculation item so it is also referred to as the assistance towards the fixed costs and making profit. This type of calculation is based on the market prices of products and services (in contrast to the absorption costing) and allows taking into account the costs affected by changes in the volume of outputs (variable costs) and fixed costs. This costing can be used within the various phases of foundry production - for example the costs consumed on core making represent a very significant cost item of foundry production process (especially in the case of complicated shapes and hollows in the castings). It is basically the calculation of an individual product - the core. The procedure of the variable costing can be applied simply. Currently it is quite common to buy cores from external suppliers, which allows us to easily determine the market price of a particular foundry core. Subsequently, the variable costs are subtracted from this market price- the direct material (e.g. consumed sand grains or binder), the direct labor of core maker (based on piecework wage), other unit costs (e.g. the stiffeners of cores) or the variable part of overheads of the core shop concerning the production of a specific core (depends on the ability of the foundry to monitor and determine certain overhead costs as variable, e.g. consumption of dyes related to the specific production of cores). The result of this calculation is the assistance towards the fixed costs and profit for a specific core, which may be an important indicia in company decision-making - whether to produce cores internally or to buy them from external suppliers. The calculation of incomplete own costs (so called variable costing) can be successfully applied in case of the other phases of foundry production. The modification of variable costing is the so called calculation with phase stratification of fixed costs. Its main distinguishing feature is the fact that the fixed costs are not assessed as an indivisible unit, their main division arises from the effort to separate the fixed costs allocated on the principle of causation from fixed costs assigned in accordance to other principles [6]. The calculation is based on the finding that the total fixed costs make up a rambling block and there are subgroups of fixed costs within this block, which are caused by various factors. The fixed costs of different groups (fixed costs of product, fixed costs of departments etc.) are subtracted from the total assistance towards the cost, thereby a number of assistance towards the cost progressively arises and the profit is represented by the last balance. The next method which foundries could

use to improve the calculation and increase the competitiveness on the market of castings is the dynamic calculation. The dynamic calculation is based on the calculation of the full own costs of outputs and, in case it is possible, it divides all the items (mainly overhead items) into fixed and variable part. The aim of this calculation is to show how the costs of individual items will be affected by changes in the volume and structure of the produced outputs [5]. This kind of calculation is mainly used as a basis for the valuation of internal outputs transmitted on the various levels of the corporate structure (e.g. the costs of produced cores, the molten metal etc.). In connection with above mentioned typical costing model of the chosen foundry and possibilities of improvement of performed calculations, it would be appropriate to exempt selected cost items (e.g. moulding shop, fettling shop, grinding shop etc.) from cumulative item of foundry overheads and to establish a more detailed differentiation and traceability within the internal centers (e.g. creation of new labor norm in selected enterprise centers and to establish most of significant wage costs as the unit costs). It enables more effective cost management throughout the production cycle of the casting. As a result, the foundry should be able to identify the cost of production of a particular cast in a specific phase of its production and thereby help to determine the real costs incurred in a particular stage of production and to relatively accurately determine the costs of eventual scrap (after determining the cause and location of their origin).

CONCLUSION

The aim of this paper was to characterize the problematic areas in the process of costing of the chosen foundry and to provide possible solutions to improve this process and thereby to enhance the competitiveness of the chosen foundry enterprise in the market of cast iron castings. The instrument used to achieve the intended aim was the analysis of the typical costing model of the specific foundry which basically represents the structure of the production process. Through this structure, the costs consumed for the implementation of enterprise outputs are identified. The costing model is divided into four basic phases - the calculation of core making, the calculation of the molten metal, the calculation of casting production and the price calculation. Foundries using this type of costing are ranked among enterprises using the calculation of the full cost (so called absorption costing). The disadvantage of the full cost calculation is that this type of costing does not monitor the different nature of the fixed and variable costs, which can, in extreme cases, cause problems in the pricing of castings produced by the chosen foundry (for example based on preliminary calculations, the foundry is not able to estimate whether the production of specific castings will be beneficial or not). The analysis revealed that the main problem lies in a significant simplification of overhead costs of the foundry. The solution to this situation may lie in a more detailed differentiation of cost items of the foundry - which means to determine costs as much as possible as unit costs and also to divide overhead costs into variable and fixed costs. This can be achieved by other forms of calculating that particularly respect the different relation of fixed and variable costs towards changes in production volume. These are mainly the calculation of incomplete costs (so called variable costing), the calculation with phase stratification of fixed costs or the dynamic calculation.

ACKNOWLEDGEMENTS

The work was supported by the specific university research of Ministry of Education, Youth and Sports of the Czech Republic No. SP2014/81.

REFERENCES

- [1] CREESE, R.C., ADITHAN, M., PABLA, B.S. Estimating and costing for the metal manufacturing industries. New York: M. Dekker, 1992. 270 p. ISBN 08-247-8712-9.
- [2] BALON, P. Řízení nákladů slévárenského podniku. Diplomová práce. Ostrava: Vysoká škola báňská - Technická univerzita Ostrava. 2010. 77s.
- [3] WEYGANDT, J.J., KIESO, D.E., KIMMEL, P.D. Managerial accounting: tools for business decision making. 5th ed. Hoboken, NJ: Wiley, 2010. ISBN 978-047-0477-144.

- [4] MAHER, M., STICKNEY, C.P., WEIL, R.L. Managerial accounting: an introduction to concepts, methods and uses. 11th ed. Mason, Ohio: South-Western Cengage Learning, 2012. 619 p. ISBN 11-115-7126-0.
- [5] HRADECKÝ, M. a kol. Manažerské účetnictví. 1. vyd. Praha: Grada, 2008. 259s. ISBN 978-80-247-2471-3.
- [6] KRÁL, B. a kol. Manažerské účetnictví. 2. vyd. Praha: Management Press, 2006. 622s. ISBN 80-7261-141-0.