STRUCTURAL ANALYSIS USED AS A TOOL TO IMPROVE THE ANALYTICAL AND INFORMATIVE FUNCTIONS OF CONTROLLING IN A METALLURGICAL ENTERPRISE

JANOVSKÁ Kamila, BESTA Petr, VILAMOVÁ Šárka, STOCH Milan, ŠVECOVÁ Eva, HRUBÁ-HENZLOVÁ Anna, MARTINKOVÁ Petra

VSB - Technical University of Ostrava, Ostrava, Czech Republic, EU,
kamila.janovska@vsb.cz, petr.besta@vsb.cz, Sarka.vilamova@vsb.cz, milan.stoch@vsb.cz, eva.svecova@vsb.cz, henzlova.hruba@seznam.cz, petra.martinikova@robe.cz

Abstract

The issue of costs and costing occupies an important place in the data base of industrial controlling. Controlling acquires the information necessary to perform all its functions through the application of various methodologies. Exact methods of decision-making, based on logical and mathematical models, can become an important source of quality information. The use of structural analysis, as one of the exact mathematical methods, can significantly increase the effectiveness and objectivity of internal and corporate management. This article presents the use of structural analysis to verify the existing method of overhead costs allocation in a selected company and introduces a calculation of the final amount of transfer rates per unit of reference variable.

Keywords: Structural analysis, Controlling, metallurgical enterprise

1. INTRODUCTION

Corporate controlling acquires information from various corporate sources in order to perform its analytical activity. This information is verified and processed by means of various methods and, subsequently, it is provided for the management in the form of recommendations and proposals, as a basis for the decision-making processes. These methods, which rely on logical and mathematical modelling of real processes and are referred to as exact decision-making methods, can play an important role in the methodological base of this approach to the scope of controlling. The use of structural analysis, as one of the exact methods of decision-making, can significantly contribute to the quality of the provided recommendations for managerial decision-making. This article presents the use of structural analysis to verify the existing method of overhead costs allocation in a selected company and introduces a calculation of the final amount of transfer rates per unit of reference variable.

2. STRUCTURAL ANALYSIS

The method of structural analysis can be considered as a tool used to study the economic balance of the production and consumer system, which is represented by every industrial enterprise. Mathematical models of production and consumer relations between the system elements and between the products and factors of production (in a tangible, value form), which are called structural models, allow a quantified analysis of the production and consumer relations [3]. Structural models in conjunction with mathematical programming allow you to solve the tasks of optimization of production and consumer relations from the viewpoints of the assumed optimal criteria, and from the viewpoint of multi-criteria decision-making. More can be found in the [1], [2].

3. CORPORATE CONTROLLING

Corporate controlling belongs to the methods of internal company management, the essence of which is a continuous process of planning, defining, measuring, evaluation of objectives and elimination of bottlenecks in

order to increase the effectiveness of the management system. Cost controlling means performing an all-purpose depth analysis, especially of costing, from various perspectives, and it deals with the issues of the classification of direct and indirect costs, the relevant choice of allocation bases of indirect costs in relation to the units of performance, and the break-even point analysis from the viewpoint of the economic situation of the company. [4]

4. ABC METHOD

The so-called ABC (Activity Based Costing) method is one of the newer methods of costing assigning costs to activities. The use of the ABC method requires a thorough description of the company processes and the preparation of an appropriate structure of internal company departments.

The use of this method is very demanding in case of planned costing operations in terms of the correct planning of reference variables, which are often represented by the consumptions of performance units within the scope of the individual production facilities (production stages) the cost unit is passing through. Correct and coherent planning of these reference variables requires a preparation of material and time output balance for the individual stages of the activities (production stages). In addition to the consumptions of the reference variables for the allocation of overhead costs, the important aspects also include the volumes (quantities) of cost units passing through these activity stages (centres). [5]

5. COSTS ALLOCATION IN SECONDARY CENTRES TO CONSUMING SECONDARY CENTRES ACCORDING TO THE REFERENCE VARIABLES BY MEANS OF ABC METHOD IN A METALLURGICAL ENTERPRISE

A detailed calculation simulation within the frame of 5 secondary centres (A-E) based on primary costs variables and the values of the created and transferred reference variables was carried out in order to determine the transfer rates per unit of reference variable (CZK/unit of reference variable).

The calculation of the amount of the final transfer rates per unit of reference variable was carried out using the repeated calculation method. The performed simulation was very time-consuming, because the differences of the calculated rates, i.e., the difference between the new rate and the previous one, were required to be less than 1 CZK. The final amounts of transfer rates were calculated after 193 steps, as you can see in **Table 1**.

The aim of all conversions and repeated rate calculations of performance transfers is to make sure the value of the product of the calculated final rates (with zero difference) and the relative variables taken by major centres (i.e. the value of secondary costs) is exactly equal to the sum of the primary cost values of all secondary centres. This is clearly visible from the previous calculations. This ensures that although secondary centres transfer their performances among themselves in various ways, all of their primary costs are eventually transferred to the major centres, and they are allocated to the calculated performances (products) using other reference variables.

If we take into account the fact that in practice the number of secondary centres is considerably higher than 5, the presented calculation (the method of repeated calculation) is very time-consuming and inefficient, because if there is any change during the calculations, e.g. a change of the primary cost, the values of the reference variables transferred only to major centres or the values of the reference variables transferred only to secondary centres, it is necessary to perform all the calculations again and repeatedly.

Table 1 The calculation of the amount of the final transfer rates per unit of reference variable

Calculation step	Supply centre									Rates difference of the new rate compared to the previous one	Withdrawing centre		
	Centre marking	Primary costs	Secondary costs	Total costs	The value of transferred reference variables to major and secondary centres	The value of transferred reference variables to major centres only	The value of transferred reference variables to secondary centres only	The value of accepted reference variables to secondary centres only	Rate in CZK/unit of reference variable		Centre marking	Value of transferred reference variables to secondary centres only	Secondary costs
1	A	**1 000 000**		1 000 000	10 000	**5 000**	5 000	13 000	100		B	**2000**	200 000
											C	**3000**	300 000
	B	**2 000 000**		2 000 000	20 000	**10 000**	10 000	5 000	100		A	**3000**	300 000
											C	**5000**	500 000
											D	**2000**	200 000
	C	**3 000 000**		3 000 000	30 000	**15 000**	15 000	23 000	100		D	**9000**	900 000
											E	**6000**	600 000
	D	**4 000 000**		4 000 000	40 000	**20 000**	20 000	11 000	100		B	**3 000**	300 000
											E	**17000**	1 700 000
	E	**5 000 000**		5 000 000	50 000	**25 000**	25 000	23 000	100		C	**15000**	1 500 000
											A	**10000**	1 000 000
2	A	1 000 000	1 300 000	2 300 000	10 000	5 000	5 000	13 000	230	130	B	2000	460 000
											C	3000	690 000
	B	2 000 000	500 000	2 500 000	20 000	10 000	10 000	5 000	125	25	A	3000	375 000
											C	5000	625 000
											D	2000	250 000
	C	3 000 000	2 300 000	5 300 000	30 000	15 000	15 000	23 000	176.67	76.67	D	9000	1 590 000
											E	6000	1 060 000
	D	4 000 000	1 100 000	5 100 000	40 000	20 000	20 000	11 000	127.5	27.5	B	3000	382 500
											E	17000	2 167 500
	E	5 000 000	2 300 000	7 300 000	50 000	25 000	25 000	23 000	146	46	C	15000	2 190 000
											A	10000	1 460 000

193	A	1 000 000	2 338 190	3 338 190	10 000	5 000	5 000	13 000	333.82	0	B	2000	667 638
											C	3000	1 001 457
	B	2 000 000	1 162 079	3 162 079	20 000	10 000	10 000	5 000	158.1	0	A	3000	474 312
											C	5000	790 520
											D	2000	316 208
	C	3 000 000	4 587 794	7 587 794	30 000	15 000	15 000	23 000	252.93	0	D	9000	2 276 338
											E	6000	1 517 559
	D	4 000 000	2 592 546	6 592 546	40 000	20 000	20 000	11 000	164.81	0	B	3000	494 441
											E	17000	2 801 832
	E	5 000 000	4 319 391	9 319 391	50 000	25 000	25 000	23 000	186.39	0	C	15000	2 795 817
											A	10000	1 863 878

The calculated amounts of the final transfer rates using repeated calculation method:
Transfers to major centres:
A: 333.82 CZK/unit of reference variable
B: 158.10 CZK/unit of reference variable
C: 252.93 CZK/unit of reference variable
D: 164.81 CZK/unit of reference variable
E: 186.39 CZK/unit of reference variable

6. THE USE OF STRUCTURAL ANALYSIS IN THE CALCULATION OF THE FINAL TRANSFER RATES PER UNIT OF REFERENCE VARIABLE

Given that the previous calculation is very time-consuming and tedious; the calculation of the final transfer rates took advantage of the method of structural analysis.

Matrix A - matrix of direct consumption coefficient was prepared on the basis of the data shown in **Fig. 1** (calculating step 1). The elements of matrix A, the direct consumption coefficient (technical coefficients) a_{ij} represent the value of production of the *i*-th field necessary to produce a unit of production of the *j*-th field. The direct consumption coefficients are shown in **Table 2**. The calculation method of the elements of matrix A is based on the standard procedure used to determine the direct consumption coefficients in the matrix of the 1st structural model quadrant.

Table 2 Direct consumption coefficients - Matrix A

	a	b	c	d	e
a	1	-0.1	-0.1	0	0
b	-0.3	1	-0.166	-0.05	0
c	0	0	1	-0.225	-0.12
d	0	-0.15	0	1	-0.34
e	-1	0	-0.5	0	1
f	0	0	0	0	0

Matrix A must be subtracted from matrix E, where matrix E is a unit one, in order to calculate the complex consumption coefficients, followed by a matrix inversion [E-A]. These and the subsequent calculations took advantage of Microsoft Excel program. Matrix B is a matrix of complex consumption coefficients and it is shown in **Fig. 3**. Its elements b_{ij} are the constants of the system in question.

Table 3 Complex consumption coefficients - Matrix B

	a	b	c	d	e
a	1.0628645949	0.1118336097	0.1395080946	0.0369810017	0.0293145119
b	0.3827136201	1.0544994887	0.2465001638	0.1081875113	0.0663637735
c	0.2459323288	0.0638366088	1.1485807830	0.2616225066	0.2267813462
d	0.4605895011	0.2070505741	0.2796665099	1.0732774934	0.3984743289
e	1.1858307593	0.1437519142	0.7137984862	0.1677922551	1.1427051850
Sum	3.3379308044	1.5809721955	2.5280540375	1.6478607681	1.8636391457

The resulting values must be multiplied by 100 (rate value in CZK / unit of reference variable presented in step 1) in order to determine the final amount of transfer rates per unit of reference variable.

Calculated values of the final amount of transfer rates by means of structural analysis method:

Transfers to major centres:
A: 3.3379 * 100 = 333.79 CZK/unit of reference variable
B: 1.5809 * 100 = 158.09 CZK/unit of reference variable
C: 2.2589 * 100 = 225.89 CZK/unit of reference variable
D: 1.6478 *100 = 164.78 CZK/unit of reference variable
E: 1.8636 * 100 = 186.36 CZK/unit of reference variable

The presented results show that the level of transfer rates per unit of reference variable calculated by means of structural analysis method and the repeated calculation method are identical. The application of the method

of structural analysis is, however, very quick and efficient. Any changes can be done simply by changing the individual elements a_{ij} in matrix A.

7. CONCLUSION

Changes in the composition and ratios of unit costs in relation to overhead ones in metallurgical enterprises make them look for new ways of cost management, because they provide information about the costs of specific activities, processes, or about the profitability of a concrete product or customer, which can significantly affect the evaluation of various projects, from corporate to multinational ones, leading to a merger or a fusion. [6], [7]

The methodology of structural analysis was used to calculate the direct consumption coefficients and the complex consumption coefficients, and it was used as the basis to determine the final amount of the transfer rates per unit of reference variable. The example shown here is substantially simplified for obvious reasons, but it can be stated that the results achieved by the calculations have real informative value and that structural model can be successfully used for the calculation of the amount of transfer rates per unit of reference variable.

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