HOW ELASTICITY INDICATORS SUPPORT COST MANAGEMENT

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Abstract
Against the background of rising overhead costs in manufacturing companies the application of methods of overhead cost management is of increasing importance. Within this article existing approaches of cost management are explained in principle. Based on these approaches a new complementary approach of managing costs with the help of costs elasticity ratios is described by a case study. The method is based on the hypothesis that there are no fixed personnel costs, but personnel costs with different elasticity with respect to the volume of orders. Personnel costs elasticity (ε) is derived from the quotient of the relative change in personnel costs (k) and the relative change of the order volume (q) of a billing month (i). The method aims to increase the flexibility of overhead costs, but can also be applied with respect to so-called direct costs. In this case, the question arises as to what extent the direct costs actually develop proportional elastic over time.

Keywords:
Cost management, Overhead costs, Direct costs, Labor costs, Elasticity

1 RISING OVERHEAD COSTS – CAUSES AND EFFECTS OF THIS TREND

The trend toward shorter product and innovation life cycles along with decreasing development and time-to-market periods is continuing [1]. At the same time, complexity and variant variety in production are also increasing as a result of global competition. This has led to increased volatility in the incoming order situation in many industries and companies. At the same time, there is also a trend toward rising overhead costs – also caused by increasing complexity and dynamism – in manufacturing and administrative departments in western industrialized nations [2] [3] [4] [5]. These additional overhead costs in areas such as procurement, logistics, maintenance, quality management or work preparation are also referred to as complexity costs [6]. According to Fischbach and Sommer [7], overhead costs make up over two-thirds of total costs in most industrial enterprises.
Direct costs are viewed as completely variable. Assuming productivity is constant, they change in a linear relationship to the output quantity. In

contrast, the overhead costs of a company are largely considered to be fixed, at least with respect to a specific period. According to this premise, if overhead costs constitute a large portion of costs, a high capacity utilization rate is necessary for a factory to reach the break-even point [8]. Companies that operate in volatile markets and have a high percentage of overhead or fixed costs face the problem of not operating profitably in periods of low demand and not reaching their financial goals [9]. In addition, cost analyses of companies that operate in volatile markets show that personnel costs classified as direct costs do not always change in a linear relationship to the output quantity. There can be many reasons for this. For example, productivity may decrease during peak order periods because of the added training time required when temporary workers are hired or because of bottlenecks that can occur in production and distribution.

2 OBJECTIVE OF THIS ARTICLE

Methods of cost management are becoming increasingly important because of the trend toward rising overhead costs in manufacturing and administrative departments. The purpose of this article is to present a new, complementary approach to managing the direct personnel costs and overhead costs of manufacturing departments and areas closely related to manufacturing. The method is based on the hypothesis that there are no fixed personnel costs, only personnel costs with different elasticity with respect to the volume of orders [9]. The aim of the method is to make managers and employees aware that a model that strictly separates direct and overhead personnel costs as well as variable and fixed personnel costs does not nearly reflect reality in a variety of ways. A much more useful cost management practice is to differentiate costs by their level of elasticity with respect to order volume and to leverage the potential flexibility of costs through resources such as flexible time recording systems. This method should be viewed as a supplementary method of cost management. It can be useful for the overall budgeting process as well as for target costs management [9].

3 FUNDAMENTALS OF COST MANAGEMENT

Cost management involves planning, controlling and monitoring costs. Cost management focuses on changes in the level, progression and structure of costs [10] [6]. The level of costs is determined using the quantity and value structure of the costs. The cost progression shows changes in costs over time. The progression of costs is often compared to the progression of a corresponding value such as revenue or sales volume. This comparison shows that costs often do not respond immediately to changes in cost drivers, such as a drop in sales volume or revenue. Another phenomenon

that may occur is a change in costs in anticipation of increased sales, for example if new personnel is recruited or machines and materials are purchased in advance. In this case, a cost progression diagram would show a change in costs prior to a change in a cost driver such as sales volume [10] [6]. Cost structure analyses can be used to classify overall costs according to fixed and variable costs as well as direct and overhead costs. Costs can also be categorized by cost type, cost center and cost object. These cost structure analyses are often combined with cost progression analyses in order to reveal trends in cost structures, initiate cost reduction activities in advance and assess their effectiveness. Additionally, individual cost management methods can be used throughout the entire product creation process – from product development to production planning to production and distribution. Budgeting and target costing are the most well-known methods of cost management.

4 COST MANAGEMENT USING ELASTICITY INDICATORS

The purpose of the developed method is to provide a simple but effective tool for cost management in the company (for method, see [9]). The method and the case example below focus on personnel costs, which are especially important in many of Germany's manufacturing industries [1] [11].
The method is based on the hypothesis that there are no fixed personnel costs, only personnel costs with different elasticity with respect to the volume of orders. However, the order volume does not necessarily have to be the same as the quantity of manufactured goods or the number of production orders. For example, in a consignment warehouse, the number of picks can be a benchmark for the volume of orders. For a manual assembly department, it can be useful to calculate the order volume as the sum of the order times of the period using standard time management methods, since these target times are usually used for estimating manufacturing costs and the sales price. In this way, the manual assembly department will increase profitability by extensively adjusting personnel costs to the changes in order times [9].
The minimum requirement for using the method is the ability to differentiate between vacation and undertime/overtime in costing for month-based time sheets. In other words, according to the definition of costs, only the hours worked in a month will be applicable to costing [9].
The central parameter of the method is elasticity, which is used primarily in macroeconomics [12]. This parameter is used to examine how the value of a dependent variable varies if the value of an independent variable is changed. The method not only considers the absolute changes to dependent and independent variables, it also takes into account the relative changes in relation to a base level [13].
Personnel cost elasticity (ε) is calculated using this method. The percentage change in personnel costs (k) of the period (i) compared to the personal

costs of the reference period (R) is used as a dependent variable. The independent variable is the percentage change in order volume (q) per period (i) compared to the order volume of the reference period (R). The personnel cost elasticity (ε) is the quotient of the dependent and independent variable:

$$\varepsilon = \frac{\frac{k_i - k_R}{k_R}}{\frac{q_i - q_R}{q_R}} = \frac{(k_i - k_R)\, q_R}{k_R\, (q_i - q_R)} \; mit\; i = \{1; 2; 3; ...\} \quad (1)$$

Personnel costs elasticity (ε) can be used to determine the extent to which personnel costs follow the order volume: The reference period is usually the accounting month with largest actual or expected order volume, or the accounting month with the lowest total personnel costs per unit or per production order. Reference values for costs and order volumes are based on a month in which the personnel cost structure in relation to the order volume is considered especially favorable.

Assuming that the reference values for personnel costs and order volumes are greater than the comparison values from other periods, the following three distinct cases emerge: A personnel cost elasticity with the value 1 means that the personnel costs have developed proportionally and elastically in relation to the order volume in comparison with the reference month, meaning the personnel costs are completely variable. If the value for personnel cost elasticity is greater than 0 and less than 1, the personnel costs have decreased to a lesser extent than the order volume. If the value for the personnel cost elasticity is greater than 1, the personnel costs have decreased to a greater extent than the order volume.

5. PROCEDURE AND EXAMPLE

The method was tested in a manufacturing department. The department manufactures products that are structurally very similar. The results of the method test were published in a simplified case study [9]. The basic procedure for using the method is described below using a simple case example. In this fictitious example, the manufacturing department has only two cost centers. The personnel costs of direct employees are recorded in cost center A and the personnel costs of the indirect employees are recorded in cost center B. The method is applied in five stages, as shown in Figure 1.

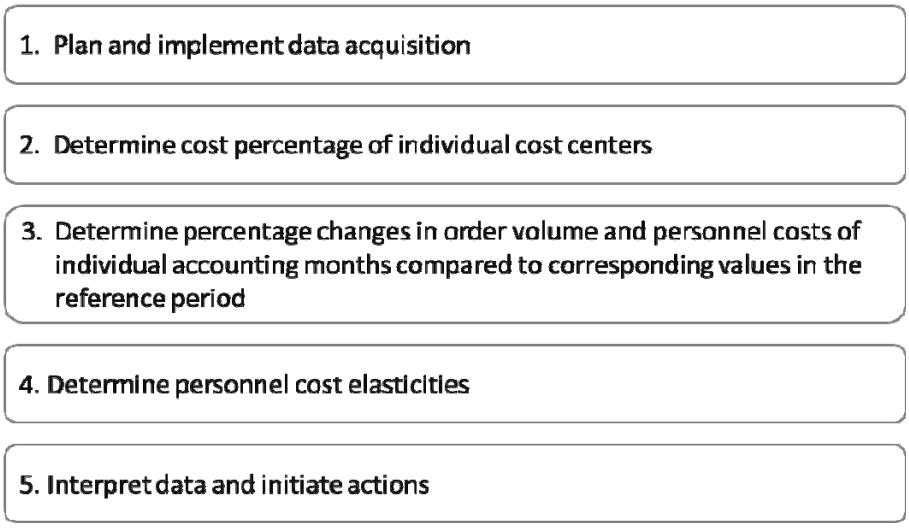

Figure 1: Procedure for using the method.

Data acquisition is planned and implemented in the first stage. This stage consists of four steps. In the first step, the area to be examined is delineated from a costing perspective by determining which cost centers and types will be included in the analysis. The assessment period is determined in the second step. The periods in the assessment period are usually months. The parameter that significantly influences costs is determined in the third step. Data are collected in the fourth step. The result is table 1, which is shown in Figure 2. As shown in table 1, demand for products is subject to seasonal fluctuations. The personnel costs for individual accounting months are listed for each cost center (CC). Cost center A contains the direct personnel costs. Cost center B includes the indirect personnel of the production department (e.g., management personnel, maintenance, quality assurance). The second column of the table lists the order volume and the fifth column lists the total personnel costs. The sixth column shows the total personnel costs per unit as the quotient of the total personnel costs and the order volume.
In the second stage of the process model, the cost percentages of the individual cost centers in the overall costs of the production department are shown. This data is useful for interpreting the cost structure. The example (see table 2 of Figure 2) shows that the percentage of direct personnel costs varies between 74% (May) and 80.4% (February). This means that direct personnel costs comprise by far the largest portion of the total personnel costs of the production department in all accounting months.

Table 1: Changes in order volume and personnel costs

CC		A	B	Σ (A-B)	
Months	Order volume [in thousands]	Direct personnel costs [K €]	Indirect personnel costs [K €]	Total personnel costs [K €]	Total personnel costs per unit [€ / unit]
Jan	200	400	100	500	2,50
Feb	220	430	105	535	2,43
Mar	180	360	100	460	2,56
Apr	140	300	95	395	2,82
May	120	270	95	365	3,04
Jun	120	270	90	360	3,00
Jul	110	260	85	345	3,14

Table 3: Relative change in order volume and personnel costs compared to reference month

	A	B	A B
Relative change in order volume [%]	Relative change in direct personnel costs [%]	Relative change in indirect personnel costs [%]	Relative change in total personnel costs [%]
-9,1%	-7,0%	-4,8%	-6,5%
-18,2%	-16,3%	-4,8%	-14,0%
-36,4%	-30,2%	-9,5%	-26,2%
-45,5%	-37,2%	-9,5%	-31,8%
-45,5%	-37,2%	-14,3%	-32,7%
-50,0%	-39,5%	-19,0%	-35,5%

Table 2: Percentage of monthly costs in total costs of month

CC		A	B	Σ (A-B)
Months	Relative change in order volume	Percentage of direct personnel costs	Percentage of indirect personnel costs	Percentage of total personnel costs
Jan	91%	80,0%	20,0%	100%
Feb	100%	80,4%	19,6%	100%
Mar	82%	78,3%	21,7%	100%
Apr	64%	75,9%	24,1%	100%
May	55%	74,0%	26,0%	100%
Jun	55%	75,0%	25,0%	100%
Jul	50%	75,4%	24,6%	100%

Table 4: Elasticity of personnel costs in relation to order volume

CC	A	B	A B
Months	Elasticity of direct personnel costs	Elasticity of indirect personnel costs	Elasticity of sum of total personnel costs
Jan	0,77	0,52	0,72
Feb			
Mar	0,90	0,26	0,77
Apr	0,83	0,26	0,72
May	0,82	0,21	0,70
Jun	0,82	0,31	0,72
Jul	0,79	0,38	0,71

Figure 2: Example of method in use.

The third stage of the process model involves defining the reference period and calculating the percentage changes in the order volume (q) (independent variable) and personnel costs (k) (dependent variable) of individual accounting months compared to the corresponding values of the reference period. The period with the largest order volume is usually selected as the reference period. February is selected as the reference period in this example. With 220 thousand units, this month has the largest order volume. At the same time, this month had the lowest personnel costs, which where €2.43 per unit. Based on the data shown in table 1 (see Figure 2), the next step involves calculating the changes in the order volume (q) (independent variable) and personnel costs (k) (dependent variable) of individual accounting months compared to the corresponding values of the

reference period of February. Table 3 in Figure 2 shows the calculation results for the percentage changes in order volume (q) (independent variable) and the personnel costs (k) (dependent variable) in comparison with the corresponding values of the reference period. For example, order volume decreased by 36.4% in April compared to February. At the same time, total personnel costs during this period decreased by only 26.2%.
In the fourth stage, personnel cost elasticities (ε) are calculated based on the results in table 3. These are obtained by dividing the relative change in personnel costs (k) by the relative change in order volume (q) in an accounting month. For example, in April, the elasticity of personnel costs for the entire manufacturing department (Figure 2, table 4) has the value 0.72, obtained by dividing -26.2% by -36.4% (see table 3). Since the value for personnel cost elasticity, which is 0.72, is less than 1, this parameter indicates that order volume has decreased somewhat more significantly than personnel costs during the same period.
In stage 5 of the process model, the data is interpreted and actions are developed based on it. Target values and specification limits for the personnel cost elasticity of individual accounting months can be defined by planning the sales volume and therefore the order volume on a monthly basis. Past values for the personnel cost elasticity of individual cost centers can be used as a basis for defining target values and specification limits. Additionally, individual cost centers can be compared so that identical conditions in individual cost centers will lead to the same requirements with regard to cost elasticity. Furthermore, the potential elasticity of personnel costs can be estimated using work and time studies in order to obtain challenging but realistic target values and specification limits for the personnel cost elasticity of individual cost centers.
The results of the case example show that managers of this manufacturing department are not sufficiently able to adjust the personnel costs recorded by cost center A to the volatile order situation. In addition, the elasticity of the costs of indirect personnel can be classified as low.

6 CRITICAL EVALUATION OF THE METHOD AND CONCLUSIONS

The method of managing personnel costs using elasticity indicators aims to make managers and employees aware that a model that strictly separates direct and overhead (personnel) costs as well as variable and fixed costs does not nearly reflect reality in a variety of ways. A much more useful cost management practice is to differentiate costs by their level of elasticity with respect to order volume and leverage the potential flexibility of costs [9].
The method presented here should be viewed as a supplementary method of cost management. It can be useful for the overall budgeting process as well as for target costs management because knowledge about the elasticity of individual costs is important, especially for planning purposes. During the budgeting process, the method can help to objectify this process

because comparable conditions in individual cost centers lead to identical requirements with respect to cost elasticity [9].
The goal of the method is to make overhead or fixed costs more flexible, but it can also be applied to costs that are typically defined as direct costs. In this case, it necessary to determine the extent to which costs that are classified as direct costs actually develop proportionally and elastically over time.
The method presented here is similar to activity-based costing because the indicator for order volume is also used to identify cost drivers. Unlike activity-based costing, the method presented here requires less work because it is based on existing cost center structures. Similar to activity-based costing, identifying the correct cost drivers is not always easy. Ideally, drivers should correlate strongly to revenue as well as costs. In summary, the proposed method can be a good compromise between the expensive activity-based costing method and existing methods with their assumptions of fixed overheads.
Another challenge of cost management with elasticity indicators is choosing the correct reference period or the correct reference values because these values have a crucial effect on the overall calculation of elasticities.
Similarly, elasticity indicators should not be considered in isolation because an isolated view of the values of these indicators can result in incorrect interpretations for three reasons: First, small changes in the two initial values (e.g., a 1% decrease in order volume, a 2% decrease in personnel costs) can have a significant effect on the value of the indicator. Second, an elasticity value of 0.5 can mean that personnel costs have decreased by 20% and order volume by 40%, resulting in two negative initial values. Another reason for an elasticity value of 0.5 is that personnel costs increased by only 20% while work volume increased by 40%. Third, it is always necessary to consider the percentage of the personnel costs of a cost center in the total costs. Therefore, when this method is used, the elasticities as well as the initial values and the weights of individual cost centers must be analyzed (see Figure 2) [9].
In the future, information about the elasticity of costs in relationship to cost drivers could also be helpful in developing better dynamic cost models for pricing, since cost-plus pricing rarely allows for a balanced allocation of costs to cost objects because of frequently high overhead rates.

REFERENCES

[1] Abele, E., Reinhart, G. (2011) Zukunft der Produktion – Herausforderungen, Forschungsfelder, Chancen. München: Hanser.
[2] Droege, W., Backhaus, K., Weiber, R. (1993) Strategien für Investitionsgütermärkte – Antworten auf neue Herausforderungen, Landsberg am Lech.
[3] Wöhe, G., Döring, U. (2010) Einführung in die Allgemeine Betriebswirtschaftslehre. 24th ed., München: Vahlen.

[4] Horvàth, P. (2011) Controlling. 12th ed., München: Vahlen.
[5] Bleiber, R. (2011) Gemeinkosten – Budgetierung, Kostenverantwortung und Kostenüberwachung. In: Bilanz & Buchhaltung – Die Zeitschrift für Buchhaltung und Rechnungswesen. 57. Jg. H. 4, pp. 14-16.
[6] Burger, A. (1999) Kostenmanagement. 3rd ed. München, Wien: Oldenbourg.
[7] Fischbach, C., Sommer, G. (2010) Standardkostenmodell als Alternative zur Prozesskostenrechnung. In: Controller-Magazin. Bd. 35 H. 2, pp. 82-86.
[8] McCormick (2001) Budgeting and Planning for Profits. In: Zandin, K. B. (ed.): Maynard´s Industrial Engineering Handbook, 5th edition, New York: McGrawHill.
[9] Hinrichsen, S. (2014) Gemeinkostenmanagement über Elastizitätskennzahlen. In: Controlling - Zeitschrift für erfolgsorientierte Unternehmenssteuerung. Jg. 26 H6, pp. 328 - 333.
[10] Reiß, M., Corsten, H. (1992) Gestaltungsdomänen des Kostenmanagements. In: Männel, W. (editor): Handbuch Kostenrechnung. Wiesbaden: Gabler, pp. 1478 - 1491.
[11] Kinkel, St., Lay, G. (2004) Produktionsverlagerungen unter der Lupe, Fraunhofer ISI, Mitteilungen aus der Produktionsinnovationserhebung, Nr. 34, Okt.
[12] Mankiw, N. G., Taylor, M. P. (2012) Grundzüge der Volkswirtschaftslehre. 5th ed., Stuttgart.
[13] Woll, A. (2008) Wirtschaftslexikon. 10th ed., München, Wien: Oldenbourg.