

THE MODELING OF INDUSTRIAL ENTITY'S DYNAMICS STAFF COSTS

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ABSTRACT

This article is devoted to a necessity of perspective value of staff costs in according to strategic business principles. The scientific and practice aspects of modeling of trends of changing staff costs of industrial entity are researched. The possibilities of models of time domain applying are estimated. The using of additive models such as moving average, smoothing fluctuations and sharing out the main trends of staff costs dynamics and also the model of exponential smoothing considering various value of a temporary row are reviewed. The appointment and features of each type of numerical modeling of staff costs level are allocated. The possibilities of applying of models of time domain for the perspective estimates of staff costs of industrial entity for forming analytical information for goals of making management decision are considered.

Key Words: *Staff Costs, Rewards, Human Capital, Time Domain, The Model Of Moving Average, The Model Of Exponential Smoothing, The Perspective Estimate, Management Decisions*

INTRODUCTION

In the changing economic conditions of business, the questions of managing decisions link with the staff costs of industrial entity in perspective are became special actual. Determination the strategy of such management costs means the dynamics of human capital development that is competitive advantage of commercial organization. In this context it is necessary to review costs both on attraction and on allowance and motivation of personnel to effective activity. In this case the investment into accumulation of personnel knowledge, abilities and skills are become important. Many researches point out this fact. J.Octavian and D. Nicoleta note that investment into education is one of way to human capital development and also to entity competitive advantage. V. Sum determines advantages in personnel abilities and skills like one of company development form which based on knowledge. So this form promotes to quality increase and efficiency of activity. In this case the development of personnel stimulation system is necessary, i.e. determination of principles and rules of personnel rewards into interrelation with strategic company goals. Y.H. Hsieh and H.M. Chen note that namely strategic accordance between business strategy and human capital strategy promotes to personnel motivation and effective activity. P. Boxall emphasizes the competitive advantage achievement as interrelation business strategy and system of rewards. B.K. Boyd and A. Salamin clarify that the bonus programs are one of the key aspects for the determination of this link. The future project of that program is a factor of stable company development. Other researchers in particular H.-M. Chen and Y.-H. Hsieh consider the necessity of interrelation personnel incentive bonus with company's life cycle stages. All of that promote to increase company competitiveness. Many specialists in particular M.B. Hargis, D.B. Bradley III, R. Barrett, S. Mayson, J.G. Messersmith

and J.P. Guthrie emphasize that such interrelation is important for companies both on stage of maturity and on origin and formation stages. Because of changes in business the evaluation of personnel rewards strategy is needed in business requirements and as a consequence the system of costs on personnel is also needed. Consequently, as W.-J.A. Chang and T.C. Huang stress the projecting for the future all of important elements of system costs on personnel including all kinds of rewards and personnel incentive bonuses. T.J. Bush has a similar opinion. He maintains that the bonuses system is important factor for increasing efficiency activity of company. This system motivates the personnel to improve their own professional skills; therefore the question of information about the perspectives of personnel bonuses system development is important for company. R. White has a similar view on this question, so he points out the necessity of a strategic approach to a determination of a logical personnel bonuses system. T.-C. Huang emphasized that the link between personnel managing with incentive bonuses is one of the element of managing system of total costs on personnel. D.-S. Wang and C.-L. Shyu share out the main factors of conformity between company developments and influence such link on the effectivity of personnel activity in perspective.

In this way the staff costs project on perspective is one of the key stages of determination of management human capital strategy in accordance with long-term and short-term business tasks. The modeling of dynamics and optimization perspectives trends serves as instruments to achievement goals. The modeling process allows finding out the changing direction of researching object, to optimize its state in future and demonstrate consecutive changes of total staff costs. It is necessary because of many processes which have impact on costs are in perpetual variation. Besides that, the dynamics costs on personnel modeling promotes to determination of changing character of financial resources in perspective directing for attraction, allowance and motivation of personnel on responsibility centers and the company's personnel categories.

METHOD

The necessity of costs on personnel dynamics modeling determines the problem of choice of concrete model of company perspective activity estimate. The information technology modern development allows using different methods of economic and statistic researches in the field of managing industrial company. In particular, it allows managing by innovative activity, finding out factors, which have influence on company's profitability, determination of optimization personnel reward strategy, budgeting of compensating and stimulating costs on personnel. This choice depends on variety factors: presence of data, the period of estimate, accuracy of trend determination and costs on modeling.

One of analytical information qualitative methods is a modeling of dynamic domains, which reflects stable trends of researching object. The costs on personnel are complex for regulation because of its changing in real calculation. In the same time that costs stable enough in long-term perspective, i.e. it's changing under the effect of transformation of forms and methods of attraction and personnel allowance. As a rule, such changes of company are consecutive with lack of interference both on outside (for example: other rates of insurance payments, the order repeats from large buyers, the appearance on strong competitor's market, high level of inflation etc.), and on inside (essential staff reduction, changing in professional personnel staff, essential corrections of tariff rates, piecework payments and salary and etc.).

In this way, the expediency of time domain application for the determination of costs on personnel character determines by dynamic rows, which allow estimating costs with goal of

finding out the trend of its changing. This is made in terms of costs planning on to follow accounting period (for example: month, quarter, year etc.) and also for correction of current plan and determination of managing of company human capital.

On the whole, depends on current goals the different models of time domain can be used. In our opinion, for the perspective estimation of costs on personnel expediently to use such models as: a) smoothing fluctuations and allocating the main tendencies of change of level of a row; b) the adaptive models considering various value of a temporary row.

The simple moving average model, which belong to first type of dynamic rows are made on the base of value averaging of researching object for few last periods. This model doesn't allow getting exact direction of events development. It more applies for the data with small accidental errors from constant or trivial changing indicator where the last observations have a weight as previous. For removing such shortcoming, the application of weighted moving average model is possible. This model is based on the idea about that the later data have larger weight than earlier.

For the data processing of time domain, the last period information is more important, i.e. for estimation costs on personnel it is necessary to know about current trend development but not about average trend from researching period of times. Namely in this context the information is estimated with using of exponential smoothing model, which allows to take into account different information value of time domain level and to eliminate the degree of obsolete primary data. It is possible because of in terms of factual value addition the error of project value is estimated (difference between real and planned value). This error by means of feedback comes to model and is considered according to process of transformation from one state in another. Thus, the self-correcting model which quickly reacts to conditions changes through the results accounting received during the previous action is determined. Owing to the specified properties, in our opinion, the model of exponential smoothing is most pertinent when forming information for adoption of management decisions.

RESULT

We investigate methodical methods of time domain models application for a perspective assessment of staff costs on the example of one of the largest Russian enterprises of petrochemical field.

Mathematically value of staff costs for future period can be expressed through model of the weighed moving average as follows:

$$f_k = \sum_{i=1}^m w_i x_{k-i} \tag{1}$$

or

$$f_k = \sum_{i=1}^m w_i x_{k-i} \tag{2}$$

Where:; (3)

- f_k - value of the estimated (projected) staff costs for k period;
- x_{k-i} - staff costs for $k-i$ period;
- w_i - weights, reflecting the level of influences of x_{k-i} sum of staff costs on the size of staff costs estimated by x_k ;

n – quantity of components.

At the same time, it is supposed that w_i doesn't increase. It reflects our opinion that than in the past are spaced far apart values of staff costs from the projected (estimated) size, subjects less it influences on future x_k value of size of costs on personnel. The quantity of components is accepted by us equal three ($n = 3$).

Analytical calculations need to be performed, leaning on primary values of costs on personnel for the research period and on a certain combination of scales. On the found optimum set of scales, it is possible to estimate in the long term costs on personnel for the next period on the enterprise or structural division: a) in general, without breakdowns on groups of costs on attraction and the personnel allowance; b) separately by types of expenses and further by its summarizing to calculate the total projected value of costs on personnel on the enterprise or structural unit.

We offer to allocate the following groups of scales:

One of the problems arising at application of this model is the question of optimum combination of scales determination. For this purpose, we recommend calculation of the modules differences sum by following formula:

$$\sum_{k=1}^n | \dots | \quad (4)$$

where: x_k – costs on personnel for k period; f_k
– has the same value as in a formula 2.

The received value is accepted to a deviation between the actual and planned value of costs on personnel for every period. By means of comparison of numbers, proceeding from the size of the values sum modules calculated by a formula 4 the optimum set of scales among above-stated is defined. We accept that the optimum combination of scales is a set with the smallest sum.

We will present calculations for a producing department of plant on production of butyl rubber of the petrochemical enterprise on the basis of primary data for twelve periods. As the chosen quantity of components equally three, the first design value of costs on personnel calculates for $k=9$ period according to a formula 2. According to this formula values of costs on personnel on each combination of scales are estimated. And, considering the smallest value of modules differences, according to a formula 4 is defined that the most optimum set of scales is the following group of scales: $w_1=0,4$; $w_2=0,3$; $w_3=0,3$.

The design size of costs on personnel of a producing department of plant on production of butyl rubber of the petrochemical enterprise for k period at this combination of scales will be following:

The carried-out calculations are presented in the table 1.

Table 1
STAFF COSTS PERSPECTIVE ASSESSMENT OF A PRODUCING DEPARTMENT OF BUTYL RUBBER PRODUCTION PLANT OF THE PETROCHEMICAL ENTERPRISE AT AN OPTIMUM COMBINATION OF SCALES ON THE BASIS OF CALCULATION OF THE SUMS OF DIFFERENCES OF MODULES OF A ROW VALUES

| Period | Costs on personnel (rub.) | | Deviation (the difference between modules), rub. |
|----------------------|---------------------------|---------------|--|
| | Real value | Planned value | |
| <i>k-12</i> - period | 844219,54 | | |
| <i>k-11</i> - period | 800140,75 | | |
| <i>k-10</i> - period | 941371,31 | | |
| <i>k-9</i> - period | 816723,88 | 869856,61 | 53132,73 |
| <i>k-8</i> - period | 800889,29 | 849143,17 | 48253,88 |
| <i>k-7</i> - period | 810445,49 | 847784,27 | 37338,78 |
| <i>k-6</i> - period | 752856,42 | 809462,15 | 56605,73 |
| <i>k-5</i> - period | 806700,33 | 784543,00 | 22157,33 |
| <i>k-4</i> - period | 821833,09 | 791670,71 | 30162,39 |
| <i>k-3</i> - period | 828464,43 | 796600,26 | 31864,17 |
| <i>k-2</i> - period | 911144,06 | 819945,80 | 91198,26 |
| <i>k-1</i> - period | 1036107,33 | 859546,88 | 176560,45 |
| <i>k</i> - period | - | 936325,48 | 547273,72 |

Further we will consider the process of costs on personnel modeling with use of exponential smoothing model. Earlier we specified that this model allows considering a deviation of the previous design size from the actual value. And, thereby to consider the tendency which has developed not on average for all analyzed interval of time, but during the periods approximate to current time.

Mathematically the size of costs on personnel for the next estimated period on the basis of exponential smoothing model is expressed as follows:

$$\Phi \quad), \quad (5)$$

Where: $f_h x_{k-1}$ - have the same value, as in a formula 2; a - the smoothing coefficient defined empirically.

Value of a constant defines extent of smoothing and is subject to the condition $0 < a < 1$ and, as a rule, is selected by a universal trial and error method. It is connected with the fact that with reduction a the deviation of exponential average decreases and increases unlike dispersion of a row. Therefore, it is necessary, on the one hand to increase the weight of fresher supervision (at increase a), and on the other hand, for alignment of casual deviations size a should be reduced. These requirements are in contradict. In this regard search of compromise size a makes a problem of model optimization.

We will consider the possibilities of this model application for a perspective costs on personnel assessment of the same petrochemical enterprise and compare the received results with the values calculated by means of model of the weighed moving average. When forming information about costs on personnel of the research enterprise on their groups the quantity of components, as well as in the previous case, is accepted equal three ($n = 3$).

Because of the constant α is defined experimentally, possible sizes of costs on personnel groups for k period are calculated proceeding from values $\alpha = 0,1$; $\alpha = 0,2$, etc. to $\alpha = 0,9$. Further the sizes of the modules differences sum like as $\sum | \quad |$ taken for distance between the actual and estimated (design) values are counted. After that by the way of direct comparison of these sizes the optimum coefficient of smoothing α between values from 0,1 to 0,9 is defined. At the same time, we accept the value of coefficient of smoothing as the number with the smallest sum. Taking into account optimum value α possible sizes of costs on personnel on its separate groups are established, and for each group of expenses the coefficient of smoothing is selected by the empirical way separately. Results of a perspective assessment of costs on personnel with use of exponential smoothing and moving average models are presented in table 2.

Table 2
STAFF COSTS PERSPECTIVE ASSESSMENT OF A PRODUCING DEPARTMENT OF BUTYL RUBBER PRODUCTION PLANT OF THE PETROCHEMICAL ENTERPRISE ON THE BASIS OF MODELS OF THE WEIGHED SLIDING AVERAGE AND EXPONENTIAL SMOOTHING

| Indicator | Weighted moving average model | | Exponential smoothing model | | Deviation of planned value (rub.) |
|---|----------------------------------|------------------------------------|-------------------------------|------------------------------------|-----------------------------------|
| | Optimum group of weights (w) | Planned value for k period, rub. | Smoothing coefficient (a) | Planned value for k period, rub. | |
| 1 | 2 | 3 | 4 | 5 | 6=5-3 |
| 1. Salary and piecework payment | 0,8; 0,1; 0,1 | 47 004,61 | 0,9 | 47 176,87 | 172,26 |
| 2. Overtime Payments | 0,8; 0,1; 0,1 | 115 721,16 | 0,9 | 116 852,14 | 1 130,98 |
| 3. Bonus | 0,6; 0,3; 0,1 | 605 661,27 | 0,6 | 603 887,56 | -1 773,71 |
| 4. Social Charges | 0,4; 0,3; 0,3 | 97 771,31 | 0,3 | 93 284,24 | -4 487,07 |
| 5. Reserve For Vacations | 0,8; 0,1; 0,1 | 1 375,00 | 0,9 | 771,75 | -603,25 |
| 6. Compensation Payments | 0,5; 0,3; 0,2 | 10 889,00 | 0,6 | 12 196,49 | 1 307,49 |
| 7. Working Clothes and Equipment of Household Rooms | 0,4; 0,3; 0,3 | 2 321,00 | 0,4 | 4 289,68 | 1 968,68 |
| 8. Costs on Workers Relocation | 0,5; 0,4; 0,1 | 86 356,42 | 0,2 | 68 951,20 | -17 405,22 |
| 9. Incentive Gifts to Workers | 0,8; 0,1; 0,1 | 1 954,00 | 0,9 | 2 032,90 | 78,9 |
| 10. Costs of personnel training | 0,8; 0,1; 0,1 | 300 854,01 | 0,9 | 306 832,67 | 5 978,66 |
| Total Costs on Personnel | - | 1 279 907,78 | - | 1 266 275,50 | -13 632,22 |

By comparison of costs on personnel perspective assessment results of the research division of the petrochemical enterprise which is carried out with use of two different models of time domain it is visible that at exponential smoothing on all levels of a row the average values are received. It has an impact on the accuracy of the end result. It is connected with the fact that at exponential smoothing all previous supervision are considered, and previous supervisions are

considered with the greatest possible weight and preceding it – with the smallest. Thus, earlier supervision has impact on the estimated (projected) values with the minimum statistical weight. In this regard the model of exponential smoothing allows receiving an assessment of costs on personnel trend parameters. This trend finds out not the average level of the research process, but the tendency created by the time of the last supervision that increases reliability of the carried-out analysis.

CONCLUSION

For modeling dynamics of costs on personnel on the basis of the analysis of time domain, it is necessary to apply the methods increasing quality of the end results – more flexible in the characteristic of the research processes, simple from the point of view of computing operations and considering the character of the direction which has developed by the time of the last supervision.

Models of time domain can be applied not only at a perspective assessment of costs on personnel. Measurement of levels of a row and tendencies of its variation allows defining stability of a temporary number of costs on personnel that is existence of a desirable tendency of development of the analyzed object with the minimum influence of adverse circumstances. Identification of a favorable tendency in costs on personnel dynamics allows to enter corrections into the system of expenses of the enterprise and to optimize its planned values.

Generalizing the above, it is possible to make a conclusion that models of temporary ranks allow to open features and properties of change of costs on personnel trends and to allocate the components of a number of the research expenses forming its level. The considered methods of numerical modeling of costs on personnel dynamics give the chance to estimate research object taking into account its reached level. Also these methods increase analytical properties of the formed information, promote data preparation for adoption of relevant administrative decisions at a principles and rules formulation of workers rewards, and as a result promote to form a company human capital management strategy.

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