

Economic assessment of the costs of developing corporate sports and physical education based on a fuzzy-multiple approach

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Abstract The aim of the study is to develop the economic assessment of corporate sports and physical education. Materials and methods. Based on the reports of the Contact Plus company (St. Petersburg) on the budget for corporate sports and physical education and indicators of working time losses for 2014-2018, the reduction in working time losses and the effectiveness of measures were calculated. Results. Indicators for evaluating cost-effectiveness of developing corporate sports and physical education were determined and their effectiveness was estimated using fuzzy logic. Conclusion. An approach to assessing economic efficiency has been developed.

Keywords: corporate sports and physical education effectiveness, economic assessment, working time losses, fuzzy multiple assessment.

I. INTRODUCTION

One of the factors of increasing labor productivity and profits of an organization is corporate sport and physical education, that is, “a set of activities related to the physical activity of employees conducted under the auspices and patronage of an enterprise (corporation)” [4,5]. Thanks to the development of this factor, the enterprise achieves a reduction in losses from seasonal and other illnesses, low working capacity, absence due to alcohol consumption, loss of working time due to smoking, etc.

To eliminate these losses and increase profits, enterprises are implementing activities in corporate physical education and sports, such as corporate fitness and corporate championships in various sports for staff and their families that promote a healthy lifestyle without smoking and alcohol.

Undoubtedly, these activities require funding. Therefore, the problem of evaluating the effectiveness of these measures arises. There is no indicator of economic efficiency in the development of corporate sports and physical education in modern scientific literature. In this research, an attempt is made to develop an approach to its assessment

II. MATERIALS AND METHODS

The study was conducted on the premises of the Contact Plus company. For analysis, the data for the period 2014-2018 were used.

As a performance indicator, the ratio of the annual cost reduction due to loss of working time (ΔC) to the company's

annual budget for the development of corporate sports and physical education (Bcs) was used:

$$\Theta = \Delta C / Bcs \quad (1).$$

The annual losses of the company are estimated based on the data from reports on the use of working time. Sick leave and absent days are taken into account, as the reasons for them are mainly connected with uncontrolled drinking after work and low level of labor discipline. The annual loss reduction is calculated as the difference between the losses of the current and previous periods. To assess the costs of the enterprise from loss of working time, the volumetric indicator of the loss of working time in hours is multiplied by the average hourly output of one employee of the enterprise in rubles.

To assess the level of effectiveness, a fuzzy multiple approach was used.

III. RESULTS AND DISCUSSION

The Contact Plus company, recognizing the need for developing corporate sports and physical education, annually increased the budget in this area (Table I).

TABLE I. ANNUAL BUDGET FOR THE DEVELOPMENT OF CORPORATE SPORTS AND PHYSICAL EDUCATION FOR 2014-2018

Parameter	Period				
	2014	2015	2016	2017	2018
Renovating sports facilities and equipment, thousand rubles	2500	200	200	200	200
Corporate championships (football, volleyball), thousand rubles	-	300	500	500	1000
Subscription to the swimming pool for employees, thousand rubles	500	1500	2500	3000	3000
Social advertisement against smoking and alcohol drinking, thousand rubles	500	500	300	300	300
Remuneration of staff, thousand rubles	120	360	600	600	600
Other, thousand rubles	-	200	500	500	500
Total	3620	3060	4600	5100	5600

During the study, there was a tendency to reduce the loss of working time due to the reduction of sick leave and absent days (Table II). This trend is due to the reduction of diseases as a result of health improvement. In addition, physical education and sports, as well as the promotion of a healthy lifestyle, have led to a reduction in alcohol consumption after work. A person engaged in sports, seeks to lead a healthy lifestyle, giving up bad habits or reducing the use of tobacco and alcohol. This results in a reduction in losses of working time caused by smoke breaks or fatigue.

TABLE II. LOSS OF WORKING HOURS OF THE COMPANY FOR 2014-2018

Parameter	Period				
	2014	2015	2016	2017	2018
Total absent days, man-day	65	62	55	52	49
Sick leave days, man-day	19.2	18.7	17.4	15.3	14.8
Absent days, man-day	6.1	5.9	6	4.8	4.4
Average working day, hours	7.98	7.97	7.98	7.99	7.97
Intra-shift losses of working time, man-hour	1.12	0.83	0.76	0.52	0.30
Non-production losses*, man-hour	1.05	0.79	0.71	0.46	0.25
Total (Line 2+ line 3)* line 4+ line 6	202.94	196.85	187.44	145.08	113.42
Average hourly output of the employee, rubles per hour	1509.7	1625.3	1689.2	1812.1	1901.9
Average headcount, persons	498	516	505	531	523
Total, thousand rubles	152579.5 1	165090.8 7	159896.6 5	139598.6 6	112822.1 4
Loss reduction, thousand rubles	-	- 12511.37	5194.23	20297.99	26776.52
Loss reduction, %	-	-8.20	3.15	12.69	19.18

* Non-production losses include the time during which the employee does not fulfill his duties - breaks, unplanned rest, etc.

The reduction in losses of working time led to a reduction in possible losses in output volumes in monetary terms. This is due to the fact that losses of working time lead to under-production. Therefore, the smaller these losses, the greater the gross output of the enterprise. It is obvious that the company annually reduces potential losses. This fact allows us to talk about an increase in the cost-effectiveness

of the development of corporate sports and physical education (Table III).

TABLE III. ECONOMIC EFFICIENCY OF COSTS FOR THE DEVELOPMENT OF CORPORATE SPORTS AND PHYSICAL EDUCATION IN 2015-2018

Parameter	Period			
	2015	2016	2017	2018
Economic efficiency of costs for the development of corporate sports and physical education	-	1.13	3.98	5.25

Performance indicators show how many times the potential savings from reduced working time losses exceed the costs of corporate sports and physical education. In 2015, there was an increase in losses compared to 2014, so the calculation of the efficiency indicator is inappropriate. In general, there is a positive trend. But the question is how high or low this indicator is. For this purpose, the fuzzy multiple approach was used.

The information support system is considered as effective when Θ , estimated by (1), is greater than a certain level $G = 0$.

This formula will allow evaluating the cost-effectiveness of the development of corporate sports and physical education, using the information available to the company. The data obtained allow us to characterize the feasibility of financing such events.

Since there is no assessment methodology that allows to determine the most reliable way of financing the development of corporate sports and physical education, a fuzzy decision-making model will be used.

If all parameters in (1) have a "fuzziness", that is, their planned value is unknown, then fuzzy numbers are appropriate as the source data. To convert formula (1) to a form suitable for using fuzzy source data, the segmented method was used. For each fuzzy number in the structure of the source data, confidence intervals are obtained $[\Delta C1, \Delta C2]$, $[Bcs1, Bcs2]$. Then, by substituting the corresponding boundaries of the intervals in (1), we obtain:

$$[\Theta_1, \Theta_2] = \left[\frac{\Delta C1}{Bcs2}; \frac{\Delta C2}{Bcs1} \right] \quad (2)$$

For each fuzzy number in the structure of the source data, confidence intervals are obtained $[\Delta C1, \Delta C2] = [-13000, 50000]$, $[Bcs1, Bcs2] = [500, 10000]$, $[G1, G2] = [-10, 100]$.

Given an acceptable level of discretization with respect to α on the membership interval $[0, 1]$, the resulting fuzzy number can be reconstructed by approximating its membership function μ_{Θ} to the broken curve by interval points.

Financing corporate sports and physical education will be considered effective when Θ , estimated by (2), is greater than a certain level $G = 0$.

Since the basic operations with fuzzy numbers are reduced to operations with their confidence intervals, and operations with intervals are expressed through operations with real numbers - the boundaries of the intervals, for a given level α , by substituting the corresponding boundaries of the intervals in (2), we obtain:

$$[\Theta_1, \Theta_2] = \left[\frac{-13000}{10000}; \frac{50000}{500} \right] = [-1,3; 100]$$

Given an acceptable level of discretization in α on the membership interval $[0, 1]$, the resulting fuzzy number $\underline{\Theta}$ can be constructed. To do this, we bring $\underline{\Theta}$ to a triangular form, limiting ourselves to calculations of fuzzy numbers of the source data using significant points.

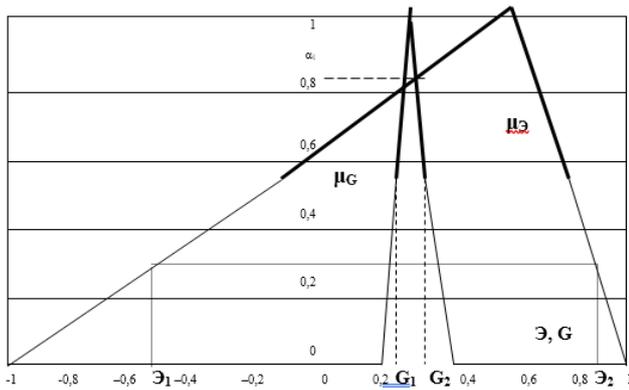


Figure 1. Θ and G membership functions

Figure 1 shows the membership function $\underline{\Theta}$ and the criteria value \underline{G} . The intersection point of these two membership functions is the point with ordinate α_1 . We choose an arbitrary membership level α and define the corresponding intervals $[\Theta_1, \Theta_2]$ $[\Theta_1, \Theta_2]$ and $[G_1, G_2]$. When $\alpha > \alpha_1$, $\Theta_1 > G_2$, the intervals do not intersect, and the confidence that the project is effective is one hundred percent, therefore, the degree of risk of inefficiency of the information support system is zero. Level α_1 can be called the upper limit of the risk zone. At $0 \leq \alpha \leq \alpha_1$, the intervals intersect.

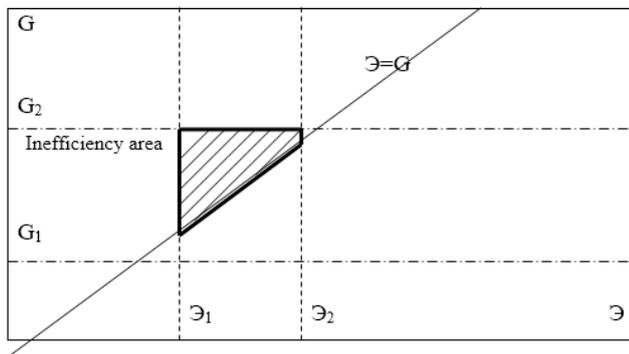


Figure 2. Phase space (Θ, G)

Figure 2 shows the inefficiency area bounded by the straight lines $G = G_1$, $G = G_2$, $\Theta = \Theta_1$, $\Theta = \Theta_2$ and the bisector of the coordinate angle $G = \Theta$.

The mutual relations of the parameters $G_{1,2}$ and $\Theta_{1,2}$ provide the following calculation for the area of the flat figure:

$$S_\alpha = \begin{cases} 0_{-at_{-\Theta_1} \geq G_2; \\ \frac{(G_2 - \Theta_1)^2}{2}, at_{-G_2 > \Theta_1 \geq G_1; \Theta_2 \geq G_2; \\ \frac{(G_1 - \Theta_1) + (G_2 - \Theta_1)}{2} (G_2 - G_1), at_{-\Theta_1 < G_1; \Theta_2 \geq G_2; \\ (G_2 - G_1)(\Theta_2 - \Theta_1) - \frac{(\Theta_2 - G_1)^2}{2}, at_{-\Theta_1 < G_1 \leq \Theta_2; \Theta_2 < G_2; \\ (G_2 - G_1)(\Theta_2 - \Theta_1), at_{-\Theta_2 \geq G_1} \end{cases} \quad (3)$$

Since all implementations (Θ, G) for a given membership level α are equally possible, the degree of inefficiency of the system $\varphi(\alpha)$ is the geometric probability that a point (Θ, G) enters the inefficiency area:

$$\varphi(\alpha) = \frac{S_\alpha}{(G_2 - G_1)(\Theta_2 - \Theta_1)} \quad (4)$$

We use the formula (3) and find the area of the flat figure. Since $\Theta_1 < G_1$, $\Theta_2 = G_2$, then

$$S_\alpha = \frac{(-10 - (-1,3)) + (100 - (-1,3))}{2} \times (100 - (-10)) = 5093$$

According to the formula (4):

$$\varphi(\alpha) = \frac{5093}{(100 - (-10))(100 - (-1,3))} = 0,457$$

Thus, a fuzzy value of efficiency was obtained in the form of the interval $[\Theta_1, \Theta_2] = [-1,3; 100]$. This means that in case of adverse circumstances, the measures for the development of corporate sports and physical education will bring the organization a loss of 1.3 rubles for each ruble of financing, and in the best case they bring profit in the amount of 100 rubles for each ruble of financing. In addition, the geometric probability of falling into the zone of inefficiency is 0.457. This probability can be described as quite low. Consequently, financing the development of corporate sports and physical education can be considered effective.

IV. CONCLUSION

Financing corporate sports and physical education is one of the necessary conditions for increasing staff productivity. For companies, the question of the ratio of costs and results remains open. The study allowed us to evaluate the economic efficiency and its level. The results of the study can be used by companies implementing activities in corporate sports and physical education.

REFERENCES

- [1] Zadeh L.A. Fuzzy sets as a basis for a theory of possibility. Fuzzy Sets and Systems. 1978. Vol.1 (1), pp. 3-28
- [2] Alexey Nedosekin. Fuzzy financial management. Moscow, AFA Library, 2003
- [3] Gil-Lafuente Anna Maria. Fuzzy Logic in Financial Analysis. Springer-Verlag Berlin Heidelberg, 2005
- [4] Galkin V. V. Economics of sport and sports business. - Moscow: KNORUS, 2006. 320 p.
- [5] E.R. Akhmetshina Et Al (2017). Tendencies and Prospects of Public-Private Partnership Development in the Field of Physical Culture and Sport, European Research Studies Journal Vol. XX Is. 2A, pp 422-430.