TECHNICAL-ECONOMIC EVALUATION SUBSYSTEMS ENERGY PRODUCTION SYSTEMS WITHIN THE LIGHT PARAMETER "ENERGY INTENSIVE"

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Abstract. The selection of the system's efficiency parameter as an essential technical one, having a major influence over the production system is justified because it directly influences the costs of the PS products, the PS expenses with energy and the technical efficiency of the production system. The efficiency is a parameter that differs from one system to another and represents an important element taken into consideration in the moment of adoption the investment decision.

Keywords: evaluation, energy, efficiency parameter, production system

1. Introduction

The production system is an economic agent of vital importance within any national economy being associated frequently with an enterprise, which represents "the organizing entity where the goods and services are produced"

The conventional thermal energy producing systems have better efficiencies than the renewable ones, but it also has to be taken into account the fact that these efficiencies are expressed relating to the quantities of conventional combustible used (in the case of conventional systems), while the renewable thermal energy producing systems use only solar energy, which is "clean" and do not exhaust the global energy reserves. The same conclusion is valid for the electric systems where, excepting hydro-electric power plants, all the conventional systems pollute the environment and reduce the energy resources (especially coal).

The identified technical and economical parameters that characterize different energy subsystems having a major influence over the production systems (PS), should be found in all energy producing systems (be they conventional or renewable) and also within the systems that contribute to the energy consumption in the PS.

The system's efficiency (η) could be considered as the first identified essential technical parameter which represents the ratio between the result of an action and the effort involved for accomplishing that action. As a characteristic of the efficiency of a technical system this parameter represents the ratio between the useful energy (*Euseful*) expressed in Wh and the energy consumed by the system (*Econsumed*) expressed also in Wh.

$$\eta = \frac{result}{effort} = \frac{E_{useful}}{E_{consumed}} \% \qquad (1)$$

The selection of the system's efficiency parameter as an essential technical one, having a major influence over the production system is justified because it directly influences the costs of the PS products, the PS expenses with energy and also the technical efficiency of the production system. The efficiency is a parameter that differs from one system to another and represents an important element taken into consideration in the moment of adoption the investment decision.

Energy-intensive economic parameters of SP (ie-SP) characterizing the energy subsystem of a system of production and indicates efficient energy utilization. This parameter is expressed in terms of operating income (EV) of the production system (SP).

According to relationship (2) parameter of the SP energy intensity has the form:

$$Ie\text{-}SP = EC / EV \quad [Wh/u.m.] \text{ or } [kWh/u.m] \qquad (2)$$

where:

EC – is the power consumption of SP expressed in [Wh] or [kWh],

EV – the SP is operating income expressed in monetary units [MU],

u.m. – is the monetary unit used.

2. Influence of parameter "energy intensity"

Energy consumption of the production system *(EC)* can be determined based on monthly electricity bills and gas emitted by energy suppliers, are specified as units of energy consumed and the price of electricity or heat. By reducing energy consumption, *energy intensity parameter of SP* is directly reflected in improved company profit [1].

However, an essential factor in assessing this parameter and the second term is the relationship (2) that is *operating income (EV) of SP* [2].

The aggregate of *operating revenue* is seen as a sum of income from the sale of goods, provision services, execution of works and other operations including forming income [2, 3].

Operating income of an SP can be determined based on *operating result (RE)* of SP, which is an indicator of its base, characterizing the absolute size of operating profitability cycle. Operating income can be determined as the difference between *operating result (RE)* and its *related costs (EC)* is:

$$EV = RE - EC \quad (3)$$

In total SP expenditure, operating costs have the greatest weight, they are directly related to the objects of it. Structure of operating expenses in the profit and loss is as follows:

- expenditure on stocks;
- staff expenditure;
- expenditure on external services;
- expenditure on other taxes and similar payments;
- compensation expenses, donations and transferred assets;
- tangible and intangible adjustments (depreciation and provisions);
- adjustment value assets (loss of receivables and sundry debtors, provisions for impairment);
- adjustments for provisions for risks and charges [2, 3, 4].

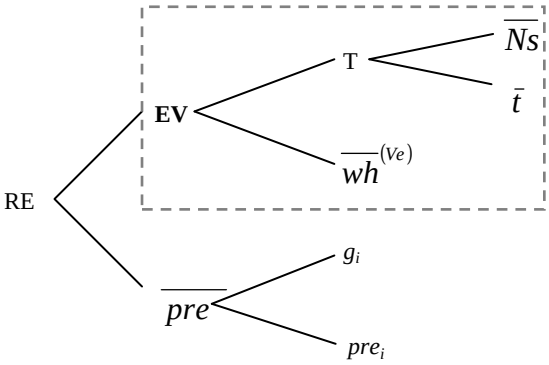
Depending on the structure of operating revenue, expenses can be grouped as appropriate (Table 1):

Table 1. Grouping revenue and operating expenses

Operating income (EV) related:	Operating expenses (EC) related:
- goods sold - stored production - production assets - other operations	- goods sold - stored production - production assets - other operations

A fundamental method of analysis of *operating income* is a *factorial analysis*. The purpose of factorial analysis is to determine the correlation between different factors of influence (internal or external, direct or indirect) and the indicator examined in order to find solutions on the recovery of business or improving future performance.

Model 1 [1, 3, 4]



Factorial analysis of operating income can be carried out on May many models, this indicator can be analyzed and together with the results from operations of SP.

Note: If this works, the model used in calculations will be presented in the box, explaining that the change in operating income (EV).

where:

RE – operating result of the SP;

EV – operating income of the SP;

$\overline{pre}$ - is the average profit (or average loss) to operating income 1 RON;

T – is the total fund for employment;

$$(EV = T \cdot \overline{wh}^{(Ve)})$$

$\overline{wh}^{(Ve)}$ - is the average hourly productivity, based on operating revenue

$\overline{Ns}$ - is the average number of employees;

$$(T = \overline{Ns} \cdot \bar{t})$$

$\bar{t}$ - is the average work per employee;

g_i - is operating income structure by type of activity;

pre_i - is profit or loss in 1 RON operating income by type of activity.

Formula model factorial analysis presented above is as follows:

$$RE = EV\left(1-\frac{EC}{EV}\right) = EV \cdot \overline{pre} \qquad (4)$$

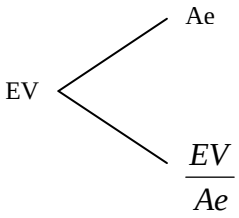
where:

$$\overline{pre} = \frac{\Sigma g_i \cdot pre_i}{100} \text{ and } pre_i = 1 - \frac{ce_i}{ve_i}$$

ve_i – the amount of operating revenue by type of activity;

ce_i – the amount of operating expenses by type of activity.

Model 2 [4]



where:

Ae – represent operating assets;

$\frac{EV}{Ae}$ – average operating income from operating activities 1 RON;

The formula used to define the model 2 is:

$$VE = Ae \cdot \frac{VE}{Ae} \qquad (5)$$

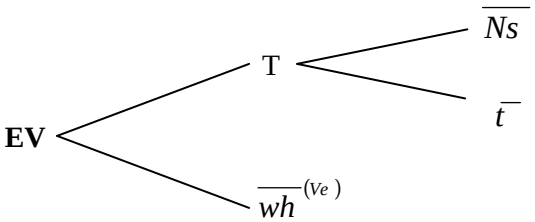
The value of operating assets (*Ae*), reflects the value of assets and related assets operating cycle. Therefore, the size determines the size of the operating assets of operating revenue, production year and operating profit. Indicator EV/Ae reflect operating efficiency assets in relation to revenues. Then will proceed to analyze the factors of income from operations for SP owned machinery and equipment manufacturing industry [5].

Model 1 the analysis presented above is a general valid for all types of production systems from the various industries and the necessary data are extracted from both the profit and loss account and balance sheet SP [5, 6] (Table 2).

Table 2. The value of economic indicators extracted from the records of the SP

Registered Indicators				
Nr. crt.	**Indicators**	**Symbol**	**Previous Year (0)**	**Current Year (1)**
1	Operating revenue (RON)	EV	168 083 977	232 550 324
2	Average number of persons (pers)	$\overline{Ns}$	927	924
3	Fund total working time (hours)	T	1 713 096	1 775 928
4	The average per employee (hours)	$\bar{t}$	1848	1922
Indicators compiled				
5	Average hourly productivity, based on operating revenue (RON/hours)	$\overline{wh}^{(Ve)}$	98.1171	130.9458

The factors are as follows:



Factorial analysis methodology and factors that influence the quantification of that model 1 is as follows:

$$\Delta EV = EV_1 - EV_0$$
$$(\Delta VE = 232\,550\,324 - 168\,083\,977 = 64\,466\,347) \qquad (6)$$

The result is due to the influence of the following factors:

1. *change the total fund for employment:*

$$\Delta T = (T_1 - T_0) \cdot \overline{wh}_0$$
$$(\Delta T = 62\,832 \cdot 98.1171 = \mathbf{6\,164\,892.36}) \qquad (7)$$

which is also due to factors:

1.1 *influence change in the average number of employees*:

$$\Delta \overline{Ns} = (\overline{Ns}_1 - \overline{Ns}_0) \cdot \bar{t}_0 \cdot \overline{wh}_0$$
$$(\Delta \overline{Ns} = -3 \cdot 1848 \cdot 98.1171 = -543\,961.0906) \qquad (8)$$

1.2. *influence change in the mean per employee*:

$$\Delta \bar{t} = \overline{Ns}_1 \cdot (\bar{t}_1 - \bar{t}_0) \cdot \overline{wh}_0$$
$$(\Delta \bar{t} = 924 \cdot 74 \cdot 98{,}1171 = 6\,708\,853.451)$$

2. *change of the medium hourly productivity:*

$$\Delta \overline{wh}^{(Ve)} = \overline{T}_1 \cdot (\overline{wh}_1 - \overline{wh}_0) \quad (8)$$

($\overline{wh}^{(Ve)}$=1775 928·32,8287=**58 301 454,64**)

3. Conclusions

- Changes in operating revenue in absolute terms was 64 466 347 RON (is a relative increase of 38.35%) which led (in terms of a relatively smaller increase in energy consumption) upgrading of economic energy intensity (Ie -SP) SP.
- Increase the total fund for employment by 3.7% of operating revenue increased by 6 164 892.36 RON, increasing explained as follows: decreased number of employees employed 3 caused a reduction in operating revenue by 543 961.0906 RON, countered by the positive influence decrease in the amount of 6 708 853.451 to increase the average employee work 74 hours per year.
- Labour productivity growth zones with 32.83 RON/hour resulted in increased operating revenue by 58 301 454.64 RON.
- In its analysis of operating results, as in the analysis of economic and financial indicators of SP developed numerous models of factorial analysis, the optimal choice is an option that makes the analysis based on indicators track.
- The approach is to test the efficiency of introducing solar energy conversion systems in order to produce a part of the total thermal and electric necessary energy, by analyzing the economic parameters affected by such a management decision. Thus, the considered parameters are: the company's energy intensity and the average rate of energy expenses.
- If the decision to implement the renewable energy system is taken, some of these parameters will improve to an extent according to the solar collectors' and PV panels' installed surfaces. However, such an investment will lead to relevant efficiency if a certain governmental support is also considered for reducing the acquisition costs and thus the recovery time.
- The results also show that in the case of the equipments and machines manufacturing systems company the parameters related to energy efficiency improve in a larger extent than in the case of the textiles industry company, given the different energy consumption levels and higher operating income of the former.

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