BENCHMARKING COMPARATIVE ALISIS USED FOR ESTIMATION OF EFFECTS OF MANAGEMENT IN PROCESS OF THE DISTRIBUTION OF ELECTRICAL ENERGY IN ENERGY COMPANIES

Jerzy Szkutnik
Częstochowa University of Technology, Poland
e-mail: szkutnik@el.pcz.czest.pl

ABSTRACT

The report presents the methodology of benchmarking as one of the key tools in management of the sector of energy distribution. It enables better functioning of enterprises due to comparing their functioning in various profiles and drawing conclusions out of these comparisons. The methodology of benchmarking for distribution companies in Poland is used to a very limited extent. However, it is expected that its role in the decision making process in the energy sector will grow significantly. The report describes a method, which enables objective comparative analysis of distribution companies according to the efficiency of energy distribution, taking into account the specificity of each company. Benchmarking by stimulation to decreasing of costs leads to creation of competitiveness of a distribution company.

1. INTRODUCTION

The experience of the more developed energy markets proves that existence of market competition brings benefits to all of its participants. An example of success can be the British energy market, where liberalisation proved the theory that market mechanisms lead to decreased energy prices. The results of the introduction of competition in the Polish power energy sector could result only in maintaining prices at the lowest justified level (stable price level, attractive to the economy, enabling domestic and foreign competition), but also better allocation of funds, reduction of costs with improved state of energy safety, reduction of labour costs, optimisation of supply, rationalisation of demand and improved position of the consumer.

2. Benchmarking in the energy distribution

The benchmarking methodology is commonly used in the European Union and the USA, where it is used practically in all sectors of the economy. In the power energy sector, it is used intensively. Analyses with usage of this tool are aimed at comparison of functioning of the distribution companies. The concept of benchmarking in this field consists in measuring results in the situation where there is no price competition. Benchmarking may consist of simple ratio analysis (unit cost, the share of administrative expenses in total costs) or analysis of more complicated statistical models. The companies have different network and customer structure. Thus, the simple ratios like costs for one kWh or costs for one km of line are not valuable ratios for measuring of efficiency. The method „network size" developed by PA Consulting Group is a method of evaluation of results of the distribution company through association of costs with the total size of the distribution network. Each element of the network is evaluated as a factor generating costs. These factors are converted through weights stemming from the average costs of distribution of the company. In this way one can compare total results of companies having different network structures.

In the model the following items are compared:
- Operating costs of the distribution and transit network up to 150 kV
- Costs of the network depreciation

- Costs of settlement of receivers and customer service

The Faculty of Electrical Engineering of the Technical University of Częstochowa has broad experience in conducting comparative analyses [3]. The methodology of taxonomy analysis based on the Prof. Hellwig method has been used, introducing so called objectivation of definite comparisons. This methodology laid the foundations of software MONITORING, implemented in a dozen of distribution companies in Poland. The software is a helpful tool for the management used for evaluation of the functioning of energy regions of a distribution company.

3. Multidimensional analysis of energy losses

The efficiency of the functioning of the network of a distribution company is evaluated on the basis of analysis of percentage loss ratio. However, there are some doubts in case of necessity to compare different distribution companies basing on this ratio. Although it is a relative figure as losses relate to energy introduced to the distribution company, such ratio neglects some structural features, which have impact on its value. Certain objective correction of the ratio for each distribution company is required. This is done by the following algorithm [4].

The starting point for analysis is the newly construed ratio – *the reaction ratio*, which was elaborated on the basis of research with usage of software STRATY`2002 PLUS [LOSSES'2002 PLUS] – the most recent version of the existing software STRATY`96, commonly used in distribution companies. The reaction ratio defines to which extent energy losses will change if the energy increases by the same value for different network levels. Such ratios are comparable among distribution companies as they contain all attributes necessary for making comparisons. Calculations of the ratios for the representative distribution company had the following results:

- network of 110 kV ; $w_{r110} = 1,073$
- network of medium voltage; $w_{rSN} = 1,68$
- network of low voltage; $w_{rnN} = 2,83$

Based on the analysis you can see the diverse impact of the flowing energy on the ultimate level of losses in the distribution network of a company. These ratios will be used for estimation of the corrected loss ratios for distribution companies, which can be used as a basis for comparison, because they possess all features required for such comparisons. The data packages need the main information about electricity energy in all levels of network and technical infrastructures(lenght of lines and numbers of substations.

As mentioned earlier, with usage of software STRATY`2002 PLUS one can conduct appropriate calculations and achieve ratios, which will enable comparisons among distribution companies. The following data constitutes an example of results from calculations:

A – Technical losses in low voltage network [MWh]

B – Technical losses in medium voltage network [MWh]

C – Technical losses in 110 kV network [MWh]

D – Total technical losses [MWh]

$\Delta E_{b\%}$ - Total balance sheet losses [%]

Co-efficient $\Delta E_{b\%}$ is an ultimate distinguishing feature of the functioning of the network of the distribution company

The corrected loss ratio for the distribution company is as follows:

$$W_{rs} = \left(\frac{C}{D} \bullet w_{r110} + \frac{B}{D} \bullet w_{rSN} + \frac{A}{D} \bullet w_{rnN}\right)$$

$$(1)$$

where : W_{rs} - the reaction ratio of the distribution company

w_{r110} - reaction ratio of the 110 kV network

w_{rSN} - reaction ratio of the medium voltage network

w_{rnN} - reaction ratio of the low voltage network

$$\Delta E_{bs\%} = \Delta E_{b\%} \bullet \frac{W_{rsu}}{W_{rs}} \qquad (2)$$

where : $\Delta E_{bs\%}$ - the corrected energy loss ratio of the distribution company

$\Delta E_{b\%}$ - the original energy loss ratio of the distribution company

W_{rsu} - the average energy loss ratio of the distribution company, calculated as: $\delta\%$

$$W_{rsu} = \frac{\sum\limits_{i=1}^{K}\sum\limits_{k=1}^{N} W_{rsi}}{(N \bullet K)} \qquad (3)$$

where: K – number of distribution companies being evaluated

N - number of years of observations, assumed $N = 5$ be compared.

Figure 1 depicts the results of the conducted research as well as original loss ratios of different distribution companies.

Figure 1. Original and corrected loss ratios of the distribution companies.
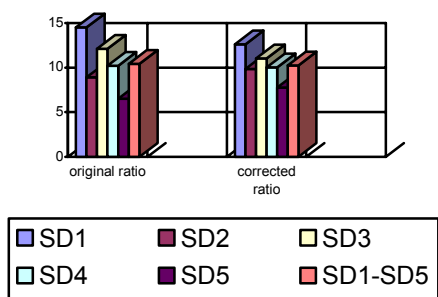
Based on the graph above, it can b stated that the corrected ratios have different values. Generally, correction results in smaller differences between companies characterised by the lowest and highest loss ratios i.e. SD1 and SD5, so:

- original value $\delta = 8\%$
- corrected value $\delta = 4,86\%$

Moreover, it is interesting that average values of the loss ratio before and after correction don't differ much (10,44% and 10,44%), which proves the correctness of the method used for objectivation of the loss ratio.

4. Software MONITORING

Similar corrections can be done for operating costs related to specific voltage level. In such a case, the correction is done only with ratios related to that voltage level.

The corrected coeficients we used to special program MONITORING

To the analysis and estimations of effects of the management the distribution of the electrical energy proposes the use of modified by the Author the programme MONITORING to the practical analysis of the comparative activity of energy-regions in distribution firms.

This estimation executed is basing on following , most essential in the activity of the region parameters: The amortization , remaining costs , the sale of the energy from the low voltage network, , the sale of the energy from the medium voltage network , generic costs together , the coefficient of balansing losses , the length of the line of the low voltage and medium voltave , the number of the station points of the purchase the network of the low and medium voltage , sale values of the electrical energy to small and great receivers and the level of the service of the customer.

As result of of analyses receives two kinds of coefficients: 1) - diagnostic (determining the complex estimation)- decisive about the market position , 2) - hierarchical - denominative the influence parameters on the final result . Nowodays is necessity to use the additional coeficient one necessary to the general estimation of effects of the management in the distribution of the electrical energy. Namely energy- firms in their own activity must take into account parameters of the service of the customer. In the moment of changes in the system of the distribution of the electrical energy the consequential necessity from the assurance to customers of high standards of the service have the essential meaning. How shows the literature of the object many factors describing on the satisfaction of the customer of the electrical energy. The analisys of author given the following ***Composite coefficient of the service of the customer,*** it consist from 5 units:
· the coefficient of the realization of the order, the rank (the influence) in Composite coefficient -30%
· the level of the reliability of deliveries - 25%
· the accessibility of the information on of deliveries - 15%
· the exactitude of bills - 15%
· the investigation of the complaint -
The power of the influence of most important parameters on the final result (the value of the diagnostic coefficient) and effects of the management with the distribution of the electrical
energy shows the Figure 2- it is represented across values of hierarchical coefficients.

Figure 2. Percentage ranks of elements diagnostic coeficient
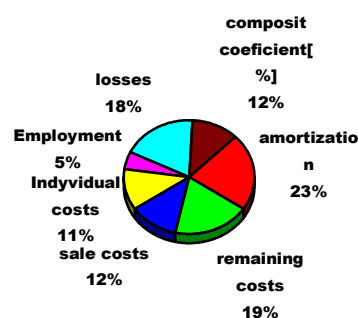
Source: Own research

The greatest influence on effects of the management with the distribution of the electrical energy in energy- regions have the amortization (23%). Presented methodology and erected on her base the programme the MONITORING helps in quick qualifying of effects of the management with the distribution of the electrical energy , what can determine for manageresses the base of correctory and development.activities

5. SUMMARY
The proposed objectivation methodology of input data for benchmarking analysis enables full reflection of differences among distribution companies. The method gives a possibility to convert the data, both technical and economic, into the comparable analytical platform.

REFERENCES
 [1] Benchmarking is coming PA Consulting Group London 2002
[2] H. Auer .Deriving efficiency scores for the Austrian distribution utilities DistribuTech EUROPE 2001 Berlin 6-8 November 2001
[3} Szkutnik J., Benchmarking as one of elements of the creation of the competitiveness of distribution companies XI Międzynarodowa Konferencja naukowa Aktualne Problemy w Elektroenergetyce, APE`2003 Gdańsk , 2003