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HMMOCS-2022
Hybrid methods of modelling and optimization in complex systems

«APPLICATION OF THE DATA ENVELOPMENT ANALYSIS METHOD FOR EVALUATING OPERATION OF TECHNICAL SYSTEMS»

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Problem statement

- Solving efficiency problems for complex technical systems is not a simple process. These systems have a complex structure and they are accompanied by production processes that require an understanding of the specifics of this activity. It is difficult for an engineering staff that does not know properly modern methods to improve efficiency to optimize processes based on information technology. It is difficult to apply these methods for employees in the field of information technology who can use them without mastering the specifics of production processes. Therefore, there is a need to conduct such scientific research to resolve this kind of problems for complex technical systems.

Solution methods

- Methods: The Data Envelopment Analysis method (DEA).
- The Charnes, Cooper and Rhodes (CCR) model of the DEA.
- The formula for calculating efficiency (Ef) according to the DEA method can be generally represented as:
- $Ef = min \frac{\sum_{i=1}^{m} V_i X_{i_0}}{\sum_{r=1}^{s} U_r Y_{r_0}}$
- Here:
- $0 \leq \frac{\sum_{i=1}^{m} V_i X_{i_j}}{\sum_{r=1}^{s} U_r Y_{r_j}} \geq 1,$
- j = 1,2,…n, r = 1,2…s, i = 1,2…m, $U_r, V_i \geq \varepsilon$.

Conclusions

Results, implementation

The efficiency indicators of the heat supply system of the fuel and energy complex were improved based on the application of the DEA method. In accordance with this objective, the following tasks will be solved:

- peculiarities of the DEA method for its application at enterprises of the heat supply system was described;
- CCR model of the DEA method was considered;
- application of the CCR model for the heat supply system, namely for CHPs and boiler houses was described;
- indicators of inputs and outputs for the enterprises under consideration were studied and determined;
- efficiency indicators of the analyzed sample were calculated;
- indicators of inputs and outputs for CHPs and boiler houses to achieve maximum efficiency were calculated.

Table. Indicators of inputs and outputs for the studied sample and their deviations to achieve performance indicators that are equal to 1

Firm	Output (y1)	Radial movement	Input(x1)	Slack movement	Input (x2)	Slack movement
1	4065.728	205.728	1405	-	672	-
2	2256.574	878.574	752	-	384	-
3	4298.862	275.862	1497	-	706	-
4	4257.599	63.599	1405	-	730	-
5	2160.638	980.638	752	-	355	-
6	3872.218	567.218	1497	-	584	-
7	4069.036	244.036	1405	-	673	-
8	1952.695	708.695	712	-	308	-
9	3866.085	511.085	1447	-	595	-
10	4138.506	152.506	1405	-	694	-
11	2144.567	425.567	712	-	366	-
12	2999.217	105.217	1297.383	-149.617	434	-
13	3820.926	441.926	1405	-	598	-

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