



Efficiency, Effectiveness and Productivity of Personnel's Health in Petrochemical Companies

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PAPER INFO	ABSTRACT
<p>Chronicle: Received: 01 April 2020 Reviewed: 05 May 2020 Revised: 20 July 2020 Accepted: 04 September 2020</p>	<p>This paper examines the petrochemical companies listed on the stock from the perspective of health indicators. Petrochemical companies are working to create health platforms to prevent accidents and reduce health costs. In this study, using two-stage data envelopment analysis technique, the efficiency and effectiveness of petrochemical companies, were investigated from a health point of view and was done by using health indicators. In this research, five inputs are used for two intermediate production and finally for the last three outputs of petrochemical companies from the aspect of human health. The results show that Maroon and Jam petrochemical Companies have been more efficient than other well-known companies and the Shazand Petrochemical company in the second part of achieving the final result of the seven petrochemical companies in total, none have had full productivity, but Maroon and Jam Petrochemicals have been targeted first and second in productivity, respectively.</p>
<p>Keywords: Efficiency. Effectiveness. Productivity. Data Envelopment Analysis. Health.</p>	

1. Introduction

The world health organization has described the workplace as an appropriate environment for health promotion. One of the most important determinants of the health status of employees is the acquisition of individual health. So the workplace is the ideal environment to support health promotion infrastructure. In recent years, business managers have used the concept of health to describe and identify issues such as increased productivity and increased effectiveness.

Health-promoting behaviors are part of a business executives' well-executed program of activities including personal happiness, physical and mental health, and social values. These behaviors have been identified as an underlying factor in the absence of many diseases. Therefore, health promotion and disease prevention and accidents are directly related to these behaviors.

Fallah, M. (2020). Efficiency, effectiveness and productivity of personnel's health in petrochemical companies, *Journal of applied research on industrial engineering*, 7(3), 280-286.

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 10.22105/jarie.2020.246206.1191



Health promoting behaviors include activities such as periodic examinations, identifying and evaluating harmful factors, providing protective equipment, having industrial health experts, having health psychologists, staff satisfaction, reducing accidents, reducing staff treatment costs, increasing staff participation in community work.

Promoting health-related behaviors will also maintain employee performance and independence, increase job quality, and reduce health and medical costs. Developed in health promotion programs developed by corporations, these behaviors are usually a combination of spiritual feeling, responsibility for their own health and that of their colleagues, maintaining social relationships in community partnerships, reducing stress management with proper management to prevent illnesses. Physically and mentally, doing physical activity, adhering to a healthy diet. As a result, this promotion will increase staff satisfaction and reduce unforeseen accidents and reduce treatment costs, thereby increasing productivity and effectiveness in estimating firm goals.

Much work has been done in the area of multilevel or multilevel data envelopment analysis that can be found in Charnes et al. [2], Ebrahimnejad et al. [4], Najafi et al. [7], Ike and Lee [6], and Chen et al. [3] noted.

Also in the field of health in petrochemical organizations and similar research has been done that can be found in Wei et al. [11], Tavakoli et al. [10], Vikas and Bansal [1], Fallah and Hosseinzadeh Lotfi [5], Pender et al. [9], and Norouzinia et al. [8].

In this paper, a two-stage model for evaluating petrochemical companies is presented. This assessment is done in terms of health. Performance indicators were collected for all petrochemical companies and experts. The innovation of this research is to present a two-stage model for evaluating petrochemical companies with health indicators.

This article has the following structure: In the second part, the introductions and basic concepts are presented. In the third section, indicators and modeling are introduced. Model implementation and results analysis are discussed in Section 4. Finally, conclusions and suggestions are presented in the fourth section.

2. Efficiency, Effectiveness and Efficiency through Data Envelopment Analysis

Learn to pronounce. Suppose a set of decision-making units as $\left\{ \left(\begin{matrix} x_1 \\ y_1 \end{matrix} \right), \dots, \left(\begin{matrix} x_n \\ y_n \end{matrix} \right) \right\}$ that is, DMU_j vector

$X_j = (x_{1j}, \dots, x_{mj})$ to generate the output vector $Y_j = (y_j, \dots, y_{mj})$ who uses that $X_j \neq 0, X_j \geq 0, Y_j \geq 0, Y_j \neq 0$. The performance of each decision-making unit comes from the following relationship.

$$\text{Efficiency of } DMU_p = \frac{UY_p}{VX_p}. \quad (1)$$

Where V and U are positive vectors of the corresponding output and input weight. Suppose each decision-making unit has a two-stage structure as follows.



In the first step, using the input vector X , the output of Z is called the intermediate output. The second step is using the Z vector to generate Y .

In many organizations the efficiency of the first stage is due to the performance of the organization and considering the quantitative and intra-organizational indicators as the efficiency and performance of the second stage to achieve the ultimate goal of the organization to the effectiveness and ultimately the overall performance of this two-stage set of integrations. The first two stages (efficiency and effectiveness) are known as productivity

Two-stage model to identify the efficiency of the first, second and total stages DMU_p , it is as follows.

$$\begin{aligned}
 & \text{Max} = UY_p, \\
 & \text{s.t.} \\
 & UY_j - WZ_j \leq 0, \forall j, \\
 & WZ_j - VX_j \leq 0, \forall j, \\
 & VX_p = 1, \\
 & U \geq 1\epsilon, V \geq 1\epsilon, W \geq 1\epsilon.
 \end{aligned} \tag{2}$$

If (V, W, U) is the optimal solution for *Model (2)* then the efficiency of the first, second and total steps is obtained from the following equations.

$$\begin{aligned}
 \text{Efficiency of } DMU_p \text{ (First Stage)} &= \frac{WZ_p}{VX_p}, \\
 \text{Effectiveness of } DMU_p \text{ (Second Stage)} &= \frac{UY_p}{WZ_p}, \\
 \text{Productivity of } DMU_p \text{ (Overall performance)} &= \frac{UY_p}{VX_p}.
 \end{aligned} \tag{3}$$

If there is an alternative optimal solution in the *Model (2)* then we used the secondary goal several times.

3. Data

In this study, seven petrochemical companies in the stock market are analyzed from the perspective of health index. The indicators considered for the study of these petrochemical companies from a health perspective are defined below.

All of the hacking indexes are based on a survey of experts from the respective companies, rated between 1 and 10 points.

Periodic Examinations. Periodic checkups of personnel of any organization, agency or individual at certain intervals of the year.

Identifying and Evaluating Harmful Factors. Identifying any factors that cause physical and psychological harm to personnel and assessing their impact.

Protective Equipment. Any type of personal and group tools and equipment to reduce the amount of accidents common in the workplace.

Industrial Health Experts. The presence and absence of an experienced expert qualitatively and quantitatively in the workplace.

Health Psychology Experts. Presence and non-presence of experienced expert in quantitative and quantitative work environment.

Employee Satisfaction. The relative satisfaction of the staff with the cooperation and continued cooperation in the workplace according to the individual's expectations of the workplace factors.

Accident Reduction. The amount of unexpected and unforeseen accidents in the workplace during the year.

Reduce the Cost of Treatment. Reduce the cost of medical care by working in the workplace, both mental and physical.

Employee Involvement. Increase the interest and presence of employees in teamwork in the workplace toward workplace goals.

Sick Leave. Reducing staff absenteeism from workplace mental illness.

Every petrochemical company makes use of health facilities and strives to create a culture of health that includes employee participation and non-use of sick leave, called corporate performance, and then expects to reduce treatment costs, number of accidents, and satisfaction. Employees need to create what is called effectiveness and collectively we call the integration of these two steps, efficiency and effectiveness. The overview of the petrochemical companies and the breakdown of these indicators are as follows.

Input Indicators:

- Periodic examinations.
- Identification and evaluation of harmful factors.
- Provision of protective equipment.
- The presence of industrial health experts.
- The rate of presence of health psychologists.

Intermediate Products:

- Staff participation rate.
- The amount of sick leave used.

Outputs:

- The rate of accident reduction.
- Reduce the cost of personnel treatment.
- Staff Satisfaction.

The values of each petrochemical company in each of the inputs, intermediate outputs and outputs are shown in *Table 1*.

Table 1. Quantities of inputs, intermediate outputs and outputs of petrochemical companies.

Jam Petrochemical Company	Khorasan Petrochemical Company	Shazand Petrochemical Company	Shiraz Petrochemical Company	Maroon Petrochemical Company	Zagros Petrochemical Company	Amir Kabir Petrochemical Company	Company Name
9	5	6	3	9	5	5	I_1 Periodic examinations
8	5	5	3	8	6	5	I_2 Identifying and evaluating harmful factors
3	3	5	3	3	5	5	I_3 Providing protective equipment
8	3	6	5	8	6	5	I_4 Existence of industrial health experts
8	3	6	5	8	6	5	I_5 Existence of health psychologists
7	3	4	6	9	3	5	k_1 Staff satisfaction
9	4	5	4	7	5	3	k_2 Accident reduction
3	5	6	3	5	6	7	O_1 Reduce staff treatment costs
3	6	4	5	2	5	2	O_2 Increase the level of employee involvement in collective work
7	3	9	3	7	7	5	O_3 Reduce sick leave

4. Analyze the Results

In this section, the efficiency, effectiveness and efficiency of each petrochemical company is calculated and analyzed. For each petrochemical company, *Model (2)* is solved with data of *Table 1*. The results of efficiency, effectiveness and efficiency of each petrochemical company are shown in *Table 2*.

Table 2. Performance of petrochemical companies in 2015.

No.	Company Name	Efficiency	Effectiveness	Performance
1	Amir Kabir Petrochemical company	0.2	0.67	0.3
2	Zagros Petrochemical company	0.26	0.88	0.3
3	Maroon Petrochemical company	0.46	0.46	1
4	Shiraz Petrochemical company	0.21	0.33	0.62
5	Shazand Petrochemical company	0.34	1	0.34
6	Khorasan Petrochemical company	0.2	0.46	0.44
7	Jam Petrochemical company	0.45	0.45	1

Table 3 shows that Maroon and Jam Kara Petrochemical companies were recognized in the first stage (efficiency), which means that they were more successful in creating a better environment for staff health than other petrochemical companies. In the second stage (effectiveness) only Shazand Petrochemical Company has been effective against others.

In sum, two steps, namely efficiency and effectiveness, in other words, the efficiency of no petrochemical company as a whole have been introduced efficiently. Maroon Petrochemical Company has the highest productivity and Jam Petrochemical Company has the highest productivity and Amir Kabir and Khorasan Petrochemical Company has the lowest productivity.

5. Conclusion

In this research, two-stage data envelopment analysis model was used to calculate the efficiency, effectiveness and efficiency of petrochemical companies from the perspective of human health. The number of petrochemical companies on the stock exchange in this study was seven that each company used five input indicators from the health point of view and in the first stage tried to create a suitable context for increasing the health of the companies and in the second phase tried to improve the health indicators. It has human resources such as reducing accidents, reducing the cost of treatment and staff satisfaction. According to the results, in the first stage two companies of Maroon and Jam Petrochemical Company and in the second stage only Shazand Kara Petrochemical Company were identified. There has been no petrochemical company that has been recognized as efficient in each of the first and second phases and as a result no petrochemical company as a whole has been fully operational.

Future research can be suggested as follows:

- If there is an undesirable outputs then how can the model be developed?
- If the outputs are interdependent then how will the model be developed?

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