A WAY TO OPTIMIZE THE ORGANIZATIONAL STRUCTURES

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Abstract—Individuals and groups operate within a framework of larger groups described as organizations. The way of employees grouping, the relationships established between them represent the organization’s structure. There are different types of structure, each of them with advantages and disadvantages, but the general trend is to change those structures in order to better adaptation to a changing environment and to improve the organization performance. The necessity of change rises when the organizations are faced with some specific problems like failure in achievement of planned objectives, slower decision process and poor decision quality, decreasing of employees’ moral, managers fatigue appearance, increasing of operations and total costs. The paper presents a way of optimizing the organizations structure by resizing the span of control and the number of management levels.

Keywords—organizational structure, span of control, management level

I. INTRODUCTION

Within the management process, the organizational structure represents a tool that may intensify the efforts for company’s objectives fulfillment.

The organizational structure represents the way the employees group and establish formal relations between them.

The way the resources – people, materials, money – are combined is decisive not only to the efficiency of the activities necessary to meet the objectives but also to the quality and the promptness of the decision making process, the configuration and the function of the informational system, the diversity of management and organizing methods and techniques, the economic environment features. [1], [2]

The organization’s structure is part of the organizing process of a company. That process involves also some other activities like decision making, communication, etc. that combined may lead to the desired level of profit and to the fulfillment of company’s objectives. [3]

The importance of the organizational structure consists mainly in conditioning the level of profit as a fundamental component of and influences the function of the management system.

The organizational structure is the skeleton of the management system. Nor only because of its impact on economic results of the organization but also because its importance for the level of work satisfaction and labour climate. [4], [5]

One may identify some assessment criteria for an organizational structure that generate specific effects on the economic results of the company [6], [7]:
1) facilitation of the human resources specialization (can lead to an increasing of productivity and work satisfaction of the individuals)
2) reasonable management costs
3) the coordination difficulty at the company and departments level
4) the response time of the system
5) the flexibility of the adaptation to change.

When a company has poor economic results is a sign for its management that a change must occur in its structure. Some of the symptoms that may lead to the idea of the necessity of structure modifications are [6]:
1) non-fulfilment of the planned objectives
2) the decision making process is slow and the quality of the decisions is low
3) the decreasing of the employees involvement
4) managers’ fatigue
5) management costs increasing
6) total costs increasing.

II. THE MAIN ELEMENTS THAT INFLUENCE THE EFFICIENCY OF AN ORGANIZATIONAL STRUCTURE

The basic elements of an organizational structure are the following:
1) job position
2) labour compartments
3) span of control
4) chain of command
5) management level, and
6) organizational relations (connections)

Even if, all the elements are important for an organization, its structure may be characterized by two parameters – n, number of management levels, and x, the
span of control size (number of persons subordinated to a
manager that depends on the nature of jobs managed).

In the same time, the number of management levels
influences the efficiency of the management work. Less
number of levels generates a larger area of control and,
as a result, a greater coordination and control efforts.

A greater number of levels conduct to a decreasing of
the responsibilities and no correlation between decision
and reality.

Because of their strong interaction between the
number of levels and the span of control, the
modification of any of those two parameters will
influence the value of the other one. The positive effects
from a certain point of view (for example, the reducing
of the number of levels and therefore the reducing of the
indirect expenses) may lead to negative consequences
from the other point of view (for example, the increasing
of the employees subordinated to a manager).

Equation (1) illustrates the relation between the
number of employees, N, and those two parameters as
average values.

\[
N = 1 + x + x^2 + x^3 + \ldots + x^{n-1} = \frac{x^n - 1}{x - 1} \quad (1)
\]

where \( x^{n-1} \) represents the number of employees, the rest
of the terms are representing the number of managers.

As a rule, the span of control decreases from the bases
of the management pyramid to its top because of the
increasing of the importance and the complexity of the
management problems. In the top of the pyramid must be
solved the most important problems that affect the
organization as a whole, while at the bases are common,
routine, day-to-day problems and therefore the span may
be larger.

The span of control may also influences the number
of relations between a manager and his or her subordinates.
For strong interactive groups where manager’s assistance
is continuous, the number of relations may be determined
by using Graicunas’s relation (2)

\[
R = X \cdot (2X^{-1} + X - 1) \quad (2)
\]

where R represents the number of relations between a
manager and its subordinates.

As one may observe, an arithmetic increase of the
span of control may generate a geometric increase of the
number of relations.

Going back to (1), if one considers N as a constant,
increasing or decreasing the other two parameters can
modify the management pyramid: \( n \) and \( x \). That indicates
a possibility to find an optimal solution for the structure.

\[\text{III. THE OPTIMIZATION OF AN ORGANIZATIONAL}
\]

\[\text{STRUCTURE}\]

In order to optimize the structure of an organization
one may have to take into consideration the variable
costs determined by the management system which are
influenced mainly by the span of control. Those costs
can by group in two categories: \( C_1(x) \) – costs generated
by the management wages and other benefits; \( C_2(x) \) –
costs generated by the increasing of the span of control
or by diminishing of the system’s coordination and
control. The result is a function that must be minimized
(3).

\[
\min F(x) = C_1(x) + C_2(x) \quad (3)
\]

\[
\text{Fig. 1. Management costs variation with the size of control area.}
\]

Fig. 1 illustrated the graphical representation of the
function.

The term \( C_1(x) \) can by write as:

\[
C_1(x) = \overline{W} \cdot (1 + x^2 + \ldots + x^{n-2}) = \overline{W} \cdot \frac{x^{n-1} - 1}{x - 1} \quad (4)
\]

where \( \overline{S} \) represents the management annual average
wage.

The term \( C_2(x) \) can by written as in (5).

\[
C_2(x) = a \cdot x^b \quad (5)
\]

where \( a \) and \( b \) represent the regression coefficients
calculated through the least-squares method used in the
case of some competing companies and illustrated by (6).

\[
\sum_{j=1}^{m} [C_2^j(x) - a \cdot x_j^b]^2 = \min \quad (6)
\]

where \( m \) represents the number of analysed companies.
Then by alloying logarithm, results (7).

\[
\sum_{j=1}^{m} [\ln C_2^j(x) - \ln a - b \cdot \ln x_j]^2 = \min \quad (7)
\]
By analysing the partial derivatives with respect to a and b, one can obtain (8).

$$
\sum_{j=1}^{m} [\ln C_2(x_j) - \ln x_j] = n \cdot \ln a + b \sum_{j=1}^{m} \ln x_j
$$

(8)

$$
\sum_{j=1}^{m} [\ln C_2(x_j) \cdot \ln x_j] = n \cdot \sum_{j=1}^{m} \ln x_j - b \sum_{j=1}^{m} (\ln x_j)^2
$$

The function $F(x)$ becomes (9).

$$
F(x) = C_1(x) + C_2(x) = \frac{S \cdot N}{x} + a \cdot x^b
$$

(9)

During the optimization process we have to take into account at least the restrictions: $x^b = \text{constant}$ and $x$ and $n$ are nonnegative variables.

In order to minimized $F(x)$ we have to determine its derivative (10)

$$
\frac{dF}{dx} = -\frac{S \cdot N}{x} + a \cdot b \cdot x^{b-1} = 0
$$

(10)

that leads us to relation (11).

$$
a \cdot b \cdot x^{b-1} = \frac{S \cdot N}{x}
$$

(11)

The experiment took place in six different industrial companies. Table I synthesizes the information regarding the structures parameters.

<table>
<thead>
<tr>
<th>No</th>
<th>Company</th>
<th>N</th>
<th>No of managers</th>
<th>W</th>
<th>C_2</th>
<th>x</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>286</td>
<td>31</td>
<td>120 x 10^6</td>
<td>10^6</td>
<td>9.22</td>
<td>3.51</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>1730</td>
<td>80</td>
<td>72 x 10^6</td>
<td>3 x 10^6</td>
<td>21.62</td>
<td>3.41</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>75</td>
<td>16</td>
<td>132 x 10^6</td>
<td>0.4 x 10^6</td>
<td>4.68</td>
<td>3.64</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>570</td>
<td>40</td>
<td>72 x 10^6</td>
<td>2 x 10^6</td>
<td>14.25</td>
<td>3.36</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>576</td>
<td>51</td>
<td>72 x 10^6</td>
<td>2 x 10^6</td>
<td>11.29</td>
<td>3.58</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>248</td>
<td>37</td>
<td>132 x 10^6</td>
<td>1.7 x 10^6</td>
<td>6.70</td>
<td>3.81</td>
</tr>
</tbody>
</table>

The values for the average annual wages and for the costs generated by the increasing of the control area or by diminishing of the system’s coordination and control were found in the accounting records of each company.

The average span of control was determined as a report between the number of employees and the number of managers.

The average number of management level was determined by using (1).

Table II presents the systematization of the computations for determination of a and b.

<table>
<thead>
<tr>
<th>No</th>
<th>Company</th>
<th>x</th>
<th>C_2(x)</th>
<th>lnC_2(x)</th>
<th>ln x</th>
<th>lnC_2(x)/ln x</th>
<th>(ln x)^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>9.22</td>
<td>10^6</td>
<td>20.72</td>
<td>2.22</td>
<td>45.99</td>
<td>4.92</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>21.62</td>
<td>3 x 10^6</td>
<td>23.82</td>
<td>3.07</td>
<td>66.98</td>
<td>9.42</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>4.68</td>
<td>0.4 x 10^6</td>
<td>19.80</td>
<td>1.54</td>
<td>30.49</td>
<td>2.37</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>14.25</td>
<td>2 x 10^6</td>
<td>21.41</td>
<td>2.65</td>
<td>56.73</td>
<td>7.02</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>11.29</td>
<td>2 x 10^6</td>
<td>21.41</td>
<td>2.42</td>
<td>51.81</td>
<td>5.85</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>6.70</td>
<td>1.7 x 10^6</td>
<td>21.25</td>
<td>1.90</td>
<td>40.41</td>
<td>3.62</td>
</tr>
</tbody>
</table>

$$
\sum_{j=1}^{6} \frac{S \cdot N}{x} = 67.76 \quad \text{and} \quad 10.1 \cdot 10^9 = 120 \cdot 10^6 \cdot 286 \Rightarrow x_1 = 13.8 \text{ persons/manager}
$$

As an example for computation of the optimum control area is presented the case for company A. The equation is:

$$
1.2 \cdot x_1^2 - 0.0886 \cdot 10^6 = \frac{120 \cdot 10^6 \cdot 286}{x_1^2} \Rightarrow x_1 = 13.8 \text{ persons/manager}
$$

By introducing that value in (1) we obtain also the optimum number of management levels which, in our case is 3.15.

By doing the same computation for each analysed company we obtained the optimum value for the control area, as shown in table III
TABLE III
THE REAL AND THE OPTIMUM SPANS OF CONTROL FOR THE SIX COMPANIES

<table>
<thead>
<tr>
<th>No</th>
<th>Company</th>
<th>Size of control area</th>
<th>No. of management levels</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Real</td>
<td>Optimum</td>
<td>Real</td>
<td>Optimum</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>9.22</td>
<td>13.8</td>
<td>3.51</td>
<td>3.15</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>21.62</td>
<td>24.9</td>
<td>3.41</td>
<td>3.30</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>4.68</td>
<td>7.87</td>
<td>3.64</td>
<td>3.31</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>14.25</td>
<td>15.03</td>
<td>3.36</td>
<td>3.32</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>11.29</td>
<td>15.10</td>
<td>3.58</td>
<td>3.32</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>6.70</td>
<td>13.56</td>
<td>3.81</td>
<td>3.08</td>
</tr>
</tbody>
</table>

After determination of the optimum span of control and management levels (as average values) is the moment to redesign the organizational charts for each company.

Fig. 2 illustrates the logical scheme of the optimization process.

Because of its importance in the general view, one may take into consideration also the human factor. To put in other words, the organizational structures must lead to objective fulfilment with the lowest economic and social costs.

A lower social cost, reflected in the employees satisfaction regarding the working conditions, relations with their supervisors, the quality of the social services, etc. may increase the economic efficiency of a company. In this way, the organizational structure contributes to a balance between group and individual interests.

The analytical method presented in the paper can help the management of the analysed companies to optimize their structures by using and iterative algorithm.

In developing the iterations is very important to know the specific for each department. If control and coordination requirements do not justify the number of managers, some of them can be moved in other department that needs more managers. If the costs of a department are high, one can divide it in smaller departments each of them with their own managers.

However, this kind of optimization process needs well-trained persons with large management, technical, sociological and psychological knowledge.

REFERENCES

IV. CONCLUSION

The role of an organizational structure must not be limited only to the organizational premises assurance for the economic objectives fulfilment at lower costs.