

# **Assessment of Managerial Performance Using Non-Financial Indicators**

Cornelia Gaber<sup>\*</sup>, Maria Stoica<sup>\*\*</sup>

\* Petroleum-Gas University of Ploiești, Bd. București 39, Ploiești, Romania

e-mail: dinugaber@yahoo.com

\*\* Nichita Stănescu – High School, 3 Nalbei, Ploiești, Romania

e-mail: pmagdastoica@yahoo.com

## **Abstract**

*Numerical or qualitative characteristics are used in statistics researches to solve some problems specific to the social and economic phenomena. A statistics population is studied according to some statistics surveys aiming at solving some problems of wide interest for the organizational management. Factorial analysis is part of the multi-varied analysis method which allows the reduction of number of the initial factors. The present paper presents an assessment method of managerial performance based on correspondences analysis. The study was made on a sample of managers from different fields of activities and according to their answers regarding the influence of the non financial indicators on the improvement of the decision making process.*

**Key words:** *correspondences analysis, economic fields, non financial indicators, factorial level, factorial axis*

**JEL Classification:** *C02*

## **Introduction**

The management concept has no well determined definition, this presenting itself in various forms, among which we mention some:

- The integration process of resources and tasks in view of achieving some organizational objectives. [Szillagy, 1981];
- The ensemble of activities specific to the organizations' achievement, management and development. [Tschirky, 1989];
- Restrictive daily operational management of the employees; the complex human activity of leadership, administration and management broadly speaking. [Mihuleac, 1994];
- The science and art of efficient management, of optimizing the capitalization of all resources in view of obtaining the success of an enterprise. [Dumitrescu, 1995];
- The conscious process of coordinating individual and group actions in order to achieve the organizational objectives in a favorable way, for a bigger part of society. [Dijmărescu, 1996].

The decision is the specific managerial act and it can be admitted that the decision has the character of a solution to a problem. According to this definition we can make a classification of *managerial attitudes*, as following:

1. Indecision – points the manager’s lack of professionalism;
2. Temporization – non identifying a sufficient number of pieces of information leads to continuing their gathering;
3. Adapting – the factor is known but can not be removed and implicitly can not compensate the effect of the consequences;
4. Attenuation – the factor is known and its effect can be reduced;
5. Correction – the factor is known and can be removed or its consequences can be removed;
6. Prevention – removing the apparition of the factor or its effects;
7. Emergency – if there is not the necessary time to prepare a decision, then the amplification of the unwanted consequences is prevented.

The pattern of managerial attributes as managerial pattern of the enterprise can be considered as an application of the closed circuit system concept. The pattern establishes that the managerial decisions are materialized due to the subordinate staff, while at the other extreme, the manager is the one to transform the information into

A main attribute of the management is the foresight, thus we can appreciate the manager’s professionalism by the quality of foresight. The field of foresight is vast and allows taking managerial decisions such as:

- resources: internal and exterior possibilities of cost reductions;
- goods: increase of performance/cost ratio;
- clients: adapting the offered goods to the clients’ requirements , still non expressed ;
- market: the size of the market portion, based on the identification of most clients’ requirements and their influencing , taking into account the duration and costs necessary to implement different decisions.

Statistics, mathematical and informatics methods and techniques offer rich theoretical information for the managerial activity.

The factorial analysis is very useful to establish some decisions regarding different technical and economical activities, by using the different characteristic methods, among which we enumerate:

- analysis with main components;
- analysis of correspondences ;
- analysis of multiple correspondences.

## Correspondence Analysis

A study regarding non financial indicators with the help of which we establish the assessment of managerial performance within the commercial company, was conducted using a sample made of 280 managers of some companies from Prahova county belonging to the IT&C, services and constructions fields.

The non financial indicators proposed to be studied are: products quality, customers’ satisfaction, company image, market position, innovation and other indicators mentioned by each manager according to the specific of the activity.

The result of the answers from the questionnaire addressed to the managers is presented in Table 1.

**Table 1.** Managers' distribution according to the company's field of activity and the used non financial indicators

Non-financial indicators	Fields of activity			Total
	IT&C	Services	Constructions	
0	1	2	3	4
Quality of products	10	34	18	62
Clients' satisfaction	16	31	24	71
Company image	18	14	19	51
Market position	9	17	21	47
Innovation	17	7	6	30
Other indicators	8	6	5	19
Total	78	109	93	280

Source: Data processed after personal research

Table 1 is a contiguity table  $N = (n_{ij})_{\substack{i=1,6 \\ j=1,3}}$  where  $n_{ij}$  is the number of managers from the

sample who answered the two study variables such as : non financial indicators ( $X$ ) respectively the company's field of activity ( $Y$ ).

According to the factorial analysis pattern [Isaic-Maniu et. al, 1995] we define the matrices:

$$D_1 = X' \cdot X = \begin{pmatrix} 62 & 0 & 0 & 0 & 0 & 0 \\ 0 & 71 & 0 & 0 & 0 & 0 \\ 0 & 0 & 51 & 0 & 0 & 0 \\ 0 & 0 & 0 & 47 & 0 & 0 \\ 0 & 0 & 0 & 0 & 30 & 0 \\ 0 & 0 & 0 & 0 & 0 & 19 \end{pmatrix} \text{ and } D_2 = Y' \cdot Y = \begin{pmatrix} 78 & 0 & 0 \\ 0 & 109 & 0 \\ 0 & 0 & 93 \end{pmatrix}.$$

The matrix of the lines profiles is :

$$D_1^{-1}N = \left( \frac{n_{ij}}{n_{i\bullet}} \right)_{\substack{i=1,6 \\ j=1,3}} = \begin{pmatrix} 0,161 & 0,549 & 0,290 \\ 0,225 & 0,437 & 0,338 \\ 0,352 & 0,275 & 0,373 \\ 0,191 & 0,362 & 0,447 \\ 0,567 & 0,233 & 0,200 \\ 0,421 & 0,316 & 0,263 \end{pmatrix}, \sum_{j=1}^3 \left( \frac{n_{ij}}{n_{i\bullet}} \right) = 1$$

And the matrix of columns profiles is :

$$ND_2^{-1} = \left( \frac{n_{ij}}{n_{\bullet j}} \right)_{\substack{i=1,6 \\ j=1,3}} = \begin{pmatrix} 0,128 & 0,312 & 0,194 \\ 0,205 & 1,284 & 0,258 \\ 0,231 & 0,128 & 0,204 \\ 0,115 & 0,156 & 0,226 \\ 0,218 & 0,065 & 0,065 \\ 0,103 & 0,055 & 0,053 \end{pmatrix}, \sum_{i=1}^6 \left( \frac{n_{ij}}{n_{\bullet j}} \right) = 1.$$

It is necessary to test the independence of the two characteristics of interest, non financial indicators respectively activity field and the statistics hypothesis for independence is set [Dumitrescu, 2005].

$$H_0 = \left\{ \frac{n_{ij}}{n} = \frac{n_{i\bullet} \cdot n_{\bullet j}}{n}, i = \overline{1,6}, j = \overline{1,3} \right\},$$

$$H_1 = \left\{ \frac{n_{ij}}{n} \neq \frac{n_{i\bullet} \cdot n_{\bullet j}}{n}, i = \overline{1,6}, j = \overline{1,3} \right\}.$$

Verifying the statistics hypothesis is made using the  $\chi^2$  test based on Person's distance for which the calculated value of the test is:

$$\chi^2_{\text{calculat}} = \sum_{i=1}^6 \left( \sum_{j=1}^3 \frac{\left( n_{ij} - \frac{n_{i\bullet} \cdot n_{\bullet j}}{n} \right)^2}{\frac{n_{i\bullet} \cdot n_{\bullet j}}{n}} \right) =$$

$$= \sum_{i=1}^6 \left( \frac{\left( n_{i1} - \frac{n_{i\bullet} \cdot n_{\bullet 1}}{n} \right)^2}{\frac{n_{i\bullet} \cdot n_{\bullet 1}}{n}} + \frac{\left( n_{i2} - \frac{n_{i\bullet} \cdot n_{\bullet 2}}{n} \right)^2}{\frac{n_{i\bullet} \cdot n_{\bullet 2}}{n}} + \frac{\left( n_{i3} - \frac{n_{i\bullet} \cdot n_{\bullet 3}}{n} \right)^2}{\frac{n_{i\bullet} \cdot n_{\bullet 3}}{n}} \right) = 29,09$$

result obtained according to the data from Tables 2 and 3.

**Table 2.** Processed data

Non-financial Indicators	Activity fields			Total
	IT&C	Services	Constructions	
0	1	2	3	4
Quality of products	10 17,271	34 24,136	18 20,593	62
Clients' satisfactions	16 19,779	31 27,639	24 23,582	71
Company image	18 14,207	14 19,854	19 16,939	51
Market position	9 13,093	17 18,296	21 15,611	47
Innovation	17 8,357	7 11,679	6 9,964	30
Other indicators	8 5,293	6 7,396	5 6,311	19
Total	78	109	93	280

Source: Data processed after individual study

**Table 3.** Processed data

$n_{ij} - n_{ij}^*$	$(n_{ij} - n_{ij}^*)^2$	$\frac{(n_{ij} - n_{ij}^*)^2}{n_{ij}}$
-7,271	52,867441	3,061
9,864	97,298496	4,031
-2,593	6,723649	0,327
-3,779	14,280841	0,722
3,361	11,296321	0,409
0,418	0,174724	0,007
3,793	14,386849	1,013

Table 2 (cont.)

-5,858	34,292732	1,727
2,061	4,247721	0,251
-4,093	16,752649	1,280
-1,296	1,679616	0,092
5,389	29,041321	1,860
8,643	74,701449	8,939
-4,679	21,893041	1,875
-3,946	15,713296	1,577
2,707	7,327849	1,384
-1,396	1,948816	0,263
-1,311	1,718721	0,272
-	-	29,09

Source: Data processed after individual study

The calculated of the test for the bilateral test:

$$\chi_{teoretic}^2 = \chi_{\frac{\alpha}{2};(r-1)(c-1)}^2 = \chi_{0,05; (6-1)(3-1)}^2 = 20,48, \text{ respectively}$$

$$\chi_{1-\frac{\alpha}{2};(r-1)(c-1)}^2 = \chi_{0,975;10}^2 = 3,25$$

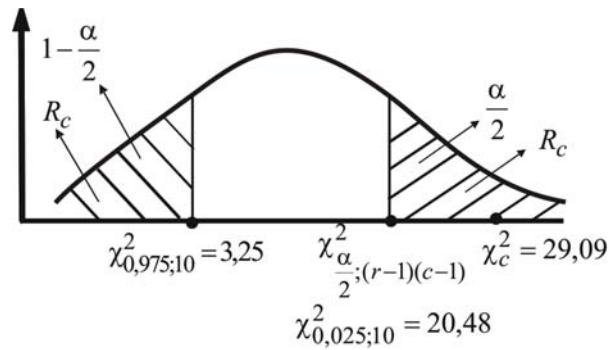


Fig. 1.  $\chi^2$  bilateral test

As  $\chi_{\text{Calculat}}^2 = 29,09 > \chi_{0,025;10}^2 = 20,48$  we reject the  $H_0$  hypothesis, so we accept the  $H_1$  hypothesis that is the studied qualitative variables are correlated, consequently the components analysis is useful and we make an analysis with the main components for the lines profile respectively columns profiles.

We determine the weight center of the lines profiles (rows):

$$g_r = \left( \frac{n_{\bullet 1}}{n} \quad \frac{n_{\bullet 2}}{n} \quad \frac{n_{\bullet 3}}{n} \right) = (0,279 \quad 0,389 \quad 0,332)$$

and the weight center of the profiles is noted and defined by

$$g_c = \left( \frac{n_{1\bullet}}{n} \quad \frac{n_{2\bullet}}{n} \quad \dots \quad \frac{n_{6\bullet}}{n} \right) = (0,221 \quad 0,253 \quad 0,182 \quad 0,168 \quad 0,107 \quad 0,069).$$

The total inaction is given by the same expression

$$I(g_r) = I(g_c) = \frac{1}{n} \cdot \chi_{\text{calculat}}^2 = \frac{1}{280} \cdot 29,09 = 0,104.$$

The total inertia is rather small so the two variables would come closer to independence. We will use the analysis of the lines profiles previously building the  $B$  matrix of the centered data.

$$B = \left( \frac{n_{ij} - \frac{n_{i\bullet} \cdot n_{\bullet j}}{n}}{n_{i\bullet}} \right)_{\substack{i=1,6 \\ j=1,3}} = \begin{pmatrix} -0,118 & 0,16 & 0,042 \\ -0,054 & 0,048 & 0,006 \\ 0,073 & -0,114 & 0,041 \\ -0,088 & -0,027 & 0,115 \\ 0,288 & -0,156 & -0,132 \\ 0,142 & -0,073 & -0,069 \end{pmatrix}.$$

The covariance matrix, noted  $V$  with regard to the weight center of  $g_r$  lines profiles is:

$$V = \frac{1}{n} B^T \cdot D_1 \cdot B = \frac{1}{280} \begin{pmatrix} 4,577507 & -3,378924 & -0,086543 \\ -3,212136 & 3,279222 & -0,067038 \\ -1,365371 & -0,067038 & 1,432409 \end{pmatrix}.$$

The reverse of the  $D_2$  matrix is:

$$D_2^{-1} = \frac{1}{\det D_2} \cdot D_2^* = \frac{1}{78 \cdot 109 \cdot 93} \begin{pmatrix} 109 \cdot 93 & 0 & 0 \\ 0 & 78 \cdot 93 & 0 \\ 0 & 0 & 78 \cdot 109 \end{pmatrix} = \begin{pmatrix} \frac{1}{78} & 0 & 0 \\ 0 & \frac{1}{109} & 0 \\ 0 & 0 & \frac{1}{93} \end{pmatrix}$$

The main axes  $a_i, i=1,2,3$  are the own normalized vectors of the matrix:

$$n \cdot V \cdot D_2^{-1} = 280 \cdot \frac{1}{280} \cdot V \cdot D_2^{-1} = \begin{pmatrix} 0,05869 & -0,031 & -0,00093 \\ -0,04118 & 0,03008 & -0,00072 \\ -0,017505 & -0,00062 & 0,01540 \end{pmatrix}.$$

The proper values of matrix  $n \cdot V \cdot D_2^{-1}$  are obtained from the equation:

$$P(\lambda) = \left| 280 \cdot V \cdot D_2^{-1} - \lambda \cdot I_3 \right| = 0 \Rightarrow \begin{vmatrix} 0,05869 - \lambda & -0,031 & -0,00093 \\ -0,04118 & 0,03008 - \lambda & -0,00072 \\ -0,017505 & -0,00062 & 0,01540 - \lambda \end{vmatrix} = 0 \Rightarrow$$

$$-\lambda^3 + 0,1042\lambda^2 - 0,0018\lambda = 0$$

$$\lambda_1 = 0,08234$$

$$\lambda_2 = 0,02186$$

$$\lambda_3 = 0$$

For  $\lambda_1 = 0,08234$  main axis  $a_1 = \begin{pmatrix} a_{11} \\ a_{21} \\ a_{31} \end{pmatrix}$  is obtained from the equation  $n \cdot V \cdot D_2^{-1} a_1 = \lambda_1 \cdot a_1$ .

For  $\lambda_2 = 0,02186$  main axis  $a_2 = \begin{pmatrix} a'_{11} \\ a'_{21} \\ a'_{31} \end{pmatrix}$  is obtained from the equation

$$n \cdot V \cdot D_2^{-1} a_2 = \lambda_2 \cdot a_2.$$

Vectors  $a_1 = \begin{pmatrix} -0,01257 \\ -0,29041 \\ 1,00000 \end{pmatrix}$  respectively  $a_2 = \begin{pmatrix} -0,03077 \\ -0,06656 \\ 1,00000 \end{pmatrix}$  have the property that the scalar

product  $\langle a_1, a_2 \rangle \neq 0$  so the vectors are not rectangular.

According to the Gram-Schmit procedure we build a basis made of rectangular and normalized  $V_1$  respectively  $V_2$ :

$$V_1 = \frac{b_1}{\|b_1\|}, V_2 = \frac{b_2}{\|b_2\|}$$

where:

$$b_1 = a_1$$

$$b_2 = a_2 - \lambda a_1 \quad \left| \begin{array}{l} \Rightarrow \langle a_2 - \lambda a_1, a_1 \rangle = 0 \\ \langle b_2, a_1 \rangle = 0 \end{array} \right. \Rightarrow \lambda = \frac{\langle a_2, a_1 \rangle}{\langle a_1, a_1 \rangle} = \frac{1,0199621}{1,084496} = 0,94049 \Rightarrow$$

$$b_2 = \begin{pmatrix} -0,01895 \\ 0,20657 \\ 0,05951 \end{pmatrix}.$$

$$\text{So } V_1 = \begin{pmatrix} -0,012070 \\ -0,278194 \\ 0,960254 \end{pmatrix} \text{ and } V_2 = \begin{pmatrix} -0,087811 \\ 0,957207 \\ 0,275758 \end{pmatrix} \text{ and for the proper value } \lambda_3 = 0$$

vector or proper ( $V_3$ ) shows no interest.

For the proper value  $\lambda_1$  the explained inertia ratio is :

$$\frac{0,08234}{0,08234 + 0,02186} \cdot 100 = 79,02\%$$

And for the proper value  $\lambda_2$  the percentage of explained inertia is:

$$\frac{0,02186}{0,08234 + 0,02186} \cdot 100 = 20,98\%,$$

while the inertia percentage of value  $\lambda_3$  is null.

In conclusion the factorial axis associated to the proper values  $\lambda_1, \lambda_2$  explains the whole inertia.

The proper vectors of the matrix  $nD_2^{-1}V$  is noted by  $u_i, i = \overline{1,3}$  and are called main factors, their components are obtained using the equations  $nD_2^{-1}Vu_i = \lambda_i u_i, i = \overline{1,3}$  where

$$nD_2^{-1}V = \begin{pmatrix} 0,058686 & -0,043320 & -0,001110 \\ -0,029469 & 0,0300085 & -0,000615 \\ -0,014681 & -0,000721 & 0,015402 \end{pmatrix} \text{ and from } nD_2^{-1}Vu_1 = \lambda_1 u_1 \text{ we}$$

$$\text{obtain } u_1 = \begin{pmatrix} 0,774053 \\ -0,448280 \\ 1,000008 \end{pmatrix} \text{ and from } nD_2^{-1}Vu_2 = \lambda_2 u_2 \text{ we obtain } u_2 = \begin{pmatrix} -0,036226 \\ -0,055958 \\ 0,990975 \end{pmatrix}.$$

The main components are  $C^1$  and  $C^2$  and we determine as following:

$$C^1 = D_1^{-1} N n D_2^{-1} u_1 = \begin{pmatrix} 0,688290 \\ 1,139614 \\ 1,784430 \\ 1,608230 \\ 1,909341 \\ 1,597759 \end{pmatrix}, C^2 = D_1^{-1} N n D_2^{-1} u_2 = \begin{pmatrix} 0,765381 \\ 0,916374 \\ 1,027571 \\ 1,256787 \\ 0,489490 \\ 0,784682 \end{pmatrix}.$$

The matrix  $C = (C^1 C^2)$  represents the coordinates of the six weight line, the first column shows the components from the first factorial axis and the second column shows the components from the second factorial axis.

The weight columns are obtained by using the weight lines coordinates in the relation:

$$Z = \lambda \cdot C^t (N D_2^{-1}), \text{ where } \lambda = \begin{pmatrix} \frac{1}{\sqrt{\lambda_1}} & 0 \\ 0 & \frac{1}{\sqrt{\lambda_2}} \end{pmatrix} = \begin{pmatrix} 3,484940 & 0 \\ 0 & 6,763566 \end{pmatrix},$$

$$Z = \begin{pmatrix} 5,226285 & 4,285332 & 4,752833 \\ 5,784580 & 6,098108 & 6,438724 \end{pmatrix}.$$

## Conclusion

The components of the three weight columns situated on the first line from  $Z$  represents the coordinate of the first factorial axis, the second line from  $Z$  represents the coordinate of the second factorial axis.

On the same factorial level, there are presented the six categories of non financial indicators and the three activity fields studied (to observe Figure 2).

The data interpretation from the factorial level can be made as following:

- on the level of non financial ensemble;
- on the level of activity field;
- simultaneously on the two ensembles.

The created grid shows the association between the two weight lines or the two categories or non financial indicators presenting a frequency similitude from the activity fields 'point of view. Indicators: products quality ( $y_1$ ) and customers' satisfaction ( $y_2$ ) matches the previous explanation, which can be also verified on the basis of the corresponding percentages calculated in the matrix  $D_1^{-1} N$ .

The connection between the two weight columns, representing two categories corresponding to the activity fields show a similitude of the frequencies in connection to the distribution of the non financial indicators from the analyzed sample. This can be achieved between the activity field IT&C ( $z_1$ ) and services ( $z_2$ ).

Taking into account simultaneously the weight lines and weight columns, then it is possible to identify the classes which are responsible for certain associations. For example the indicators from the ( $y_1$ ) products quality category and customers' satisfaction ( $y_2$ ) together have a similar behavior towards the IT&C fields ( $z_1$ ) and respectively services ( $z_2$ ).



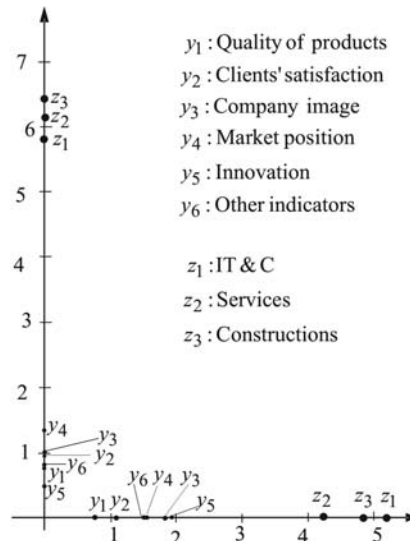


Fig. 3. The graphical representation on the same factorial level of the categories of non financial indicators and activity fields

Following the performed analysis we draw a general conclusion and that is products or services quality and clients' satisfaction represents important factors in assessing the managerial performances.

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## Evaluarea performanței manageriale folosind indicatori non-financiari

### Rezumat

*Caracteristicile numerice sau calitative sunt folosite în cercetări statistice pentru rezolvarea unor probleme specifice fenomenelor de natură socio- economică. O populație statistică este studiată pe baza unor sondaje statistice, urmărindu-se rezolvarea unor probleme de mare interes pentru managementul organizațional. Analiza factorială se încadrează în metodele analizei multivariate care permite reducerea numărului de factori inițiali. Articolul prezintă o metodă de evaluare a performanței manageriale pe baza analizei corespondențelor. Studiul a fost efectuat pe un eșantion de manageri din diferite domenii de activitate și în funcție de răspunsurile acestora privind influența indicatorilor non-financiari asupra îmbunătățirii procesului decizional.*