CONTROL PROCESSES IN HUMAN CAPITAL MANAGEMENT USING PERFORMANCE BENCHMARKING

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Abstract

Human resources control is a methodical process based on decision-making tools and takes into account the evolution of an organization's internal and external environment. The tools and procedures used in this process do not always allow for frequent performance evaluations that would be needed in order to identify useful trends.The difficulty is especially noticeable in case of companies or institutions where the processes are not formally defined and in which the working time is explicitly determined. Similar situations can be found in areas where internal control is less developed or where effective monitoring is not carried out consistently.

The organizations with an insufficiently developed internal control system perform less frequently analyzes and control processes specific to human resources. Suitable tools are also needed within the organizations which have not implemented an adequate internal control system to help managers to identify and implement specific actions according to the organizational context at a certain point in time.

The authors have defined and compared three quantitative analysis tools that can form the foundation for rapid redesign of human resource needs by implementing internal benchmarking. The methods provide managers and internal control practitioners with the possibility to quickly implement specific human capital minimal processes (e.g in planning or redesigning areas) that are neccesary to make real-time decisions, especially in the public sector.

Keywords: human resources redesign, internal control, linear optimization, human capital.

JEL classification: O15, C61, J24

Introduction

Internal control, as a management function, should be rather viewed from a proactive-constructive perspective, having a role of motivating and harmonizing actions rather than from a reactive-destructive perspective, regulating some established anomalies or deficiencies, finding responsible persons and setting penalties or sanctions [1].

In this context, there is also the human resources control which includes the planning, evaluation and control of both the performance of employees and staff working in the human capital field [2]. Employees can be defined as a cost factor, with potential added value and as a stakeholder group [3].

Human resource control helps ensure competitive advantage, facilitates the identification and minimization of risks to which the organization may be exposed, and also creates prerequisites for achieving certain results such as: increasing transparency, improving efficiency and increasing value added or performance [4].

Currently, organizations use specific and well-known tools in the field of human resource control, such as: staff reports, performance measurement systems, balanced scorecard, benchmarking, competence and skills control [5]. Instruments similar to the above mentioned ones are also used as a good practice in the public sector [6].

A practical example in this respect is the enactment by the Romanian Government of Ordinance no. 3/2017 regarding some measures for central public administration. The Ordinance established

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the creation of the Committee for the Analysis of Institutional Organization and Human Resources in the Central Public Administration. The Committee is an advisory body without legal personality, whose main role is to carry out an analysis of the current situation of institutional organization and organizational charts for all public administration authorities and institutions (including deconcentrated entities) and to propose measures for streamlining the management of human resources in the central public administration.

The need for such an analysis is due to the natural need of a self-regulation which implies ensuring a proper correlation between the human resource needs and the activities carried out and which relates to the management-forecasting phase [7].

The content of staff management forecasting consists of a set of well thought-out methodological and analytical efforts to foresee and detect potential issues, to identify trends and patterns, to conceive optimal solutions subsequently materialized in action plans, and to correct actions as tasks are performed. The purpose of predictive staff management is both to ensure the future of the organization and to minimize the impact of inherent risks [8].

Taking into account the current development of the society and the dynamics of some trends in the field of forecasting management there are necessary periodical and often quick, real time analyzes. Therefore, management needs to perform frequently such an analysis in order to determine trends and evaluate impact assessments [9].

In view of the above, the purpose of this study is to operationalize appropriate tools for a quick analysis of the efficient allocation of human resources.

We would like to mention that the present study is only applicable to organizations with a large number of staff and territorial structures (especially in the case of central public institutions that have territorial subunits, deconcentrated entities etc).

Another hypothesis and also another limitation of the study is given by the fact that it is only applicable to organizations which have not developed high level internal control standards or have not defined sound business processes that allow effective worktime and work tasks calculations in a very short time.

Regarding the literature review, we mention the human resources control studies developed by Milkovich and Boudreau (1993) [10].

The use of benchmarking analysis with the aim to compare the organization's substructures and the use of data to improve and then integrate any methods has also been developped in Anderson’s (2016) [11] research papers who identifies the stages of performance analysis by providing the relationships and interdependencies between them.

Likewise, Feigenbaum (1951) [12] uses benchmarking (including internal benchmarking) as a tool of continuous measurement and comparison of business processes.

If we consider the use of benchmarking processes, we must emphasize the data envelopment analysis tool developed by Farrel (1957) [13].

Other recent human resource control studies using such quantitative techniques have been developed by Lotfi (2010) [14] or Ramanathan (2003) [15], and a structured approach to controlling human resources belongs to River (2012) [16] and Olexova (2011) [17].

Description of the Methodology

As stated in the introductory part, this study refers to an organization with a large number of employees, which directly coordinates other territorial units or branches and has not implemented an adequate internal control system.

A hypothesis considered by the authors is that for each subunit the same types of activities are carried out which have specific and well-defined key performance indicators. The study is referring exclusively to these cases.

With regard to specific indicators, a first hypothesis taken into consideration is that they may be performance or effort indicators. Each of these types can provide a clear insight into the status of activities and the amount of work done by an employee.

According to art. 129 of the Labor Code, "The work norm expresses the amount of work required to carry out operations or work tasks by an appropriately qualified person who works at a normal intensity under the conditions of certain technological and working processes".

It should be noted that working norms include productive time, time for interruptions imposed by the technological process and time for legal breaks in the work program.

Work norms shall be drawn up by the employer in accordance with the regulations in force or, in the absence of norms, the working rules shall be developed by the employer after consulting the representative union or, where appropriate, the employees representatives.

A correct assessment of professional performance can not be achieved without normalization of work. Normalization of labor implies difficult analytical processes and analysis of the operations flows.

The present study avoids these analytical processes and bases the decision only on a comparison of the effort made at the level of some subunits affiliated to the same central entity.

The proposed tool offers managers the opportunity to carry out practical and simplified analyzes in order to optimize the allocation of resources even if the normalization of the work has not been fully realized.

The hypothesis from which the authors went was that optimal allocation ensures the achievement of the permanent balance that needs to be ensured between resources (staff numbers) and effort (various indicators that quantify the effort).

As stated above, the diagnosis of organizational goals can be represented by indicators that quantify the effort (e.g the average number of files prepared) or indicators that quantify performance (e.g the number of files drawn up erroneously / the number of files drawn up). In the study we considered the indicators that quantify the effort (which are the basis of the labor standards) and which were generically recorded.

Regarding human resource specific indicators, we can consider both the number of staff per structure (which will be the indicator used in the present study), but also other indicators such as: fluctuation of staff by type (voluntary/involuntary), occupation time of a vacancy, the satisfaction or commitment of staff, the average value of performance ratings etc.

The main activities that take place within organizations have a certain degree of relevance given by a coefficient of importance and can be defined by specific effort indicators. For example, if we consider as an indicator the number of files we have prepared, we can have effort specific indicators for each type of processed file.

These activities can generally be defined in a very minimal way even in general acts of organizations (such as organizational regulations, incorporation documents etc) without adequate analytical development of flows (e.g procedures containing specific tools for managing processes such as business process management that includes the amount of work required, working times etc).

Therefore, even if there is an insufficient internal control development to detail these activities by people, working times, procedures, operations etc, it can be considered as a starting point to allow a minimum analysis specific to human resource control.

If we consider the importance of producing an indicator for an activity, we can give grades from 1 to 10 that represents the importance coefficients. Obviously, the effort indicators considered can be constructed for different periods and can be represented as in table 1 below.

Table 1

Database with indicators

Indicator	**Period 1**	**Period 2**	**......**	**Period n**
Indicator 1	a_{11}	a_{12}		a_{in}
Indicator 2	a_{21}	a_{22}		a_{2n}
Indicator n	a_{n1}	a_{n2}		a_{nn}

Source: Authors own research results.

Another limitation of the study is given by the fact that the analysis was performed by internal benchmarking only for the dataset of a single time period. In later developments the study will be extended with cross-sectional data providing a dynamic analysis.

We considered that for each subunit we have defined the matrix with the indicators described above and the number of job positions that represent the human resource specific indicator as outlined above. The data set for the analysis will encompass the number of staff for each substructure, the related effort indicators and the importance coefficients. In order to achieve the benchmarking goal, the models followed (as we considered as a hypothesis) an optimal relationship between the resources (number of job positions) and the achievement of certain activities.

A first approach to an internal benchmarking process was to determine the number of positions calculated by weighing the effort for each type of activity through a model using a scorecard [18]. Such a model is based on the fact that the sum of the products between the coefficients (which adds up to 100%) and the indicators can be weighted with the total, resulting another aggregate indicator that measures the number of staff for each structure, given the total number of jobs available. Obviously, the model can be extended to several measures. However, for simplicity of representation we will still consider that there is only one measure.

To exemplify such an approach in table 2 below we have considered a model in which it is analyzed the number of positions in each substructure, relative to a total number of possible positions and to specific effort indicators. Therefore, the first column presents a case where a number of jobs are assigned to the subunits, and in the following columns are represented the effort indicators and the weights of the activities types for each subunit.

The sum for each subunit resulted by multiplying every indicator and its weight determines an aggregate indicator against which can be weighed the number of optimized staff relative to the total number of jobs. The column of the weighted amounts to the total weights amount represents the ratio between the sum of the indicators and their weight for each subunit and the sum of all these partial amounts. The indicator determines a number of calculated positions (if the total number of job positions is considered constant), which can be compared to the number of existing positions, resulting a gap that determines the areas in which the human resource is in excess compared to other subunits. This gap may be the basis for subunit redistribution of staff that is operative and assures efficiency.

If we assume, for example, that there are 5 types of activities marked with activity 1 through activity 5, the calculations using the indicators and weights can be presented according to table 2 below.

The result of the above model provides a first way to establish a gap between the job positions that should exist at territorial structures (the number of jobs calculated by optimization according to the scorecard model) and the number of existing jobs. Thus, the positive values in the difference column indicate an additional need for human resources which can be distributed from the subunits that record the highest negative values in absolute value.

As a mathematical representation, we can conclude that the number of job positions calculated with this method is given by the equation:

$n_i = N \times (\sum i_i \times c_j) / (\sum(\sum i_i \times c_j))$

where N – total number of job positions

i_i – the effort indicator for each subunit

c_j – the coefficient for each indicator with $\sum c_j = 1$

A second approach used a linear optimization algorithm. The concept of optimization is well-established as the core principle in the analysis of complex decision-making or allocation issues. Within this concept, an objective is maximized or minimized and subject to restrictions limiting the choice of decision variables.

Table 2

Scorecard aggregation model

Job Positions	Process Effort Indicator 1	Process Effort Indicator 2	Process Effort Indicator 3	Process Effort Indicator 4	Process Effort Indicator 5	Weight Process 1	Weight Process 2	Weight Process 3	Weight Process 4	Weight Process 5	Amount Effort Indicatos x Weights	Weight Amount Effort Indicators / Total Amount of Weights	Computed job positions	Difference between the Calculated and Existent Job Positions
13	150.0	1386.0	149.0	66.4	119.6	6	2	6	10	8	6187.512168	0.02149395	11	-2
15	61.0	1366.2	110.0	80.1	97.5	6	2	6	10	8	5338.576879	0.01854495	10	-5
11	223.2	2270.5	374.0	97.1	217.3	6	2	6	10	8	10834.22056	0.037635513	19	8
14	312.6	2182.6	159.6	50.6	168.2	6	2	6	10	8	9050.212857	0.031438293	16	2
11	207.4	2193.3	306.7	88.0	250.6	6	2	6	10	8	10356.71396	0.035976768	19	8
12	26.7	738.2	114.7	28.2	136.2	6	2	6	10	8	3696.690121	0.012841425	7	-5
11	113.8	1758.8	178.3	47.5	70.9	6	2	6	10	8	6312.351853	0.021927613	11	0
9	106.8	1108.4	128.4	44.9	68.0	6	2	6	10	8	4620.551066	0.016050699	8	-1
16	128.4	1185.8	203.9	127.1	241.6	6	2	6	10	8	7569.745376	0.0262955	14	-2
15	142.9	1531.2	361.8	46.4	114.0	6	2	6	10	8	7466.030167	0.025935218	13	-2
14	105.2	888.0	288.5	39.3	74.5	6	2	6	10	8	5127.557941	0.01781192	9	-5
12	43.7	1021.6	41.7	25.2	52.7	6	2	6	10	8	3228.77792	0.011216009	6	-6
19	124.3	2132.4	99.7	274.0	184.0	6	2	6	10	8	9820.642308	0.034114582	18	-1
11	168.1	1994.7	251.5	177.2	255.0	6	2	6	10	8	10318.79589	0.03584505	19	8
11	144.4	730.8	72.2	25.2	77.7	6	2	6	10	8	3635.350672	0.012628346	7	-4
11	188.0	1724.8	370.2	81.4	168.8	6	2	6	10	8	8963.214825	0.031136083	16	5
12	404.9	2094.4	311.8	43.2	147.8	6	2	6	10	8	10103.25939	0.035096327	18	6
16	120.9	1986.5	262.3	69.4	156.4	6	2	6	10	8	8216.993207	0.028543886	15	-1
10	99.4	848.8	234.7	45.2	73.8	6	2	6	10	8	4744.740785	0.016482104	9	-1
11	96.8	1698.7	189.6	25.7	94.2	6	2	6	10	8	6126.80878	0.021283081	11	0
12	183.6	1284.6	184.3	49.8	130.9	6	2	6	10	8	6321.324397	0.021958782	11	-1
13	125.5	1560.9	116.7	37.8	103.9	6	2	6	10	8	5784.3549	0.020093477	10	-3
11	124.5	767.4	118.7	25.0	68.8	6	2	6	10	8	3793.962535	0.013179326	7	-4
14	189.1	1484.9	389.9	215.9	229.0	6	2	6	10	8	10434.65747	0.036247525	19	5
13	15.3	779.8	54.2	325.5	180.4	6	2	6	10	8	6674.276267	0.023184853	12	-1
13	64.3	2064.4	126.9	61.8	133.6	6	2	6	10	8	6962.154371	0.024184873	13	0
9	211.6	1012.9	308.8	35.3	48.9	6	2	6	10	8	5892.061538	0.020467624	11	2
13	198.1778	1815.606	349.7335	79.95733	212.4227	6	2	6	10	8	9417.634412	0.032714629	17	4
12	118.8393	1817.974	313.6397	29.18904	144.0043	6	2	6	10	8	7674.748081	0.026660255	14	2
13	179.9004	1860.654	442.7729	47.28276	94.2149	6	2	6	10	8	8683.893852	0.030165788	16	3
15	152.6639	2848.202	533.4059	104.5427	241.9937	6	2	6	10	8	12794.19923	0.044444014	23	8
11	150.0098	948.2073	107.6531	29.68011	67.68958	6	2	6	10	8	4280.709324	0.014870169	8	-3
10	64.90337	1115.881	125.6535	104.0555	113.3312	6	2	6	10	8	5322.307969	0.018488436	10	0
15	123.0081	1082.327	241.8283	86.09029	157.8861	6	2	6	10	8	6477.663739	0.022501868	12	-3
16	165.8395	2711.559	538.9866	70.87008	216.0978	6	2	6	10	8	12089.55709	0.041996254	22	6
11	222.5805	1304.021	279.1892	23.53382	66.52198	6	2	6	10	8	6386.175205	0.022184058	11	0
14	35.92248	1932.943	49.34111	147.7843	223.0844	6	2	6	10	8	7639.985205	0.026539497	14	0
12	57.4298	638.5181	31.96826	19.28789	61.05654	6	2	6	10	8	2494.755766	0.00866619	4	-8
11	151.379	1500.489	410.7938	26.43159	84.04039	6	2	6	10	8	7310.6534	0.025395476	13	2
15	182.0067	769.9873	321.893	20.68743	91.8213	6	2	6	10	8	5504.817239	0.01912243	10	-5
11	139.3557	1012.745	52.60631	32.43864	88.99779	6	2	6	10	8	4213.631971	0.014637158	8	-3
518	5824.299	61155.88	9307.682	3054.978	5527.355	246	82	246	410	328	287872.2707	1	521	3

Source: Authors own research results.

The formulation of the optimization problem involves identifying a balance between building a sufficiently complex model to better describe the problem and the ease of solving it. The Simplex method for solving linear programming problems, introduced in 1947 by George B. Dantzig [19] is, in essence, a matrix method.

Specifically, in relation to the problem addressed in the study, this tool can seek to find a required number of jobs that minimize the difference between the number of available positions on each substructure and the number of calculated jobs. This involves building a model that flattens the differences between the number of jobs calculated for each subunit, relative to the number of jobs existing at a certain time.

The model starts from the hypothesis that the number of positions required is proportional to the same coefficient and the weighted sum of the values of each effort indicator. The function objective of the simplex algorithm becomes the minimization of the squares of the differences between the calculated jobs and the existing jobs.

Hence, the calculated number of staff $_i$ can be written as a single coefficient (k) multiplied by a sum of products (a x indicator 1_i + b x indicator 2_i + c x indicator 3_i + d x indicator 4_i + e x indicator 5_i), where a, b, c, d, e are the weighting coefficients for each indicator. Therefore, the simplex algorithm will look for that value (k) that minimizes the differences between the number of staff calculated with the above formula and the number of existing staff.

We present in table 3 below the simplex model for the same data used in the first model. The model was developed using the MS Excel Solver tool.

From the analysis of table 3 we note that, as in the first case, the result of the model provides a difference between the jobs that should exist and the number of existing jobs.

Table 3

The aggregation model using the simplex algorithm

Subunit	Existing Jobs	Process Effort Indicator 1	Process Effort Indicator 2	Process Effort Indicator 3	Process Effort Indicator 4	Process Effort Indicator 5	Weight Process 1	Weight Process 2	Weight Process 3	Weight Process 4	Weight Process 5	Product Indicator x Weight 1	Product Indicator x Weight 2	Product Indicator x Weight 3	Product Indicator x Weight 4	Product Indicator x Weight 5	Calculated Jobs	Difference
1	13	150.0	1386.0	149.0	66.4	119.6	6	2	6	10	8	899.8018	2771.938	894.2666	664.4951	957.0102	11	2
2	15	61.0	1366.2	110.0	80.1	97.5	6	2	6	10	8	365.7704	2732.393	659.9907	800.7705	779.6528	10	5
3	11	223.2	2270.5	374.0	97.1	217.3	6	2	6	10	8	1339.242	4541.034	2244.089	971.0581	1738.798	19	-8
4	14	312.6	2182.6	159.6	50.6	168.2	6	2	6	10	8	1875.763	4365.28	957.6635	505.593	1345.914	16	-2
5	11	207.4	2193.3	306.7	88.0	250.6	6	2	6	10	8	1244.611	4386.689	1840.437	879.7878	2005.189	19	-8
6	12	26.7	738.2	114.7	28.2	136.2	6	2	6	10	8	160.4972	1476.449	688.0875	282.3709	1089.285	7	5
7	11	113.8	1758.8	178.3	47.5	70.9	6	2	6	10	8	682.9583	3517.517	1070.014	474.7886	567.0735	11	0
8	9	106.8	1108.4	128.4	44.9	68.0	6	2	6	10	8	640.5487	2216.783	770.4457	448.8132	543.9608	8	1
9	16	128.4	1185.8	203.9	127.1	241.6	6	2	6	10	8	770.6423	2371.7	1223.655	1271.09	1932.659	14	2
10	15	142.9	1531.2	361.8	46.4	114.0	6	2	6	10	8	857.2075	3062.471	2170.686	464.0557	911.6097	13	2
11	14	105.2	888.0	288.5	39.3	74.5	6	2	6	10	8	631.0621	1775.935	1730.986	393.4569	596.1179	9	5
12	12	43.7	1021.6	41.7	25.2	52.7	6	2	6	10	8	261.9382	2043.118	250.3626	252.0627	421.2967	6	6
13	19	124.3	2132.4	99.7	274.0	184.0	6	2	6	10	8	745.685	4264.837	598.3748	2739.759	1471.986	18	1
14	11	168.1	1994.7	251.5	177.2	255.0	6	2	6	10	8	1008.429	3989.44	1508.989	1771.961	2039.977	19	-8
15	11	144.4	730.8	72.2	25.2	77.7	6	2	6	10	8	866.638	1461.651	433.3423	251.956	621.7629	7	4
16	11	188.0	1724.8	370.2	81.4	168.8	6	2	6	10	8	1128.158	3449.644	2221.284	813.9852	1350.144	16	-5
17	12	404.9	2094.4	311.8	43.2	147.8	6	2	6	10	8	2429.557	4188.833	1870.681	431.9371	1182.252	18	-6
18	16	120.9	1986.5	262.3	69.4	156.4	6	2	6	10	8	725.2077	3973.036	1574.09	693.771	1250.889	15	1
19	10	99.4	848.8	234.7	45.2	73.8	6	2	6	10	8	596.2855	1697.66	1408.472	451.6929	590.6307	9	1
20	11	96.8	1698.7	189.6	25.7	94.2	6	2	6	10	8	581.0311	3397.335	1137.51	257.1567	753.7761	11	0
21	12	183.6	1284.6	184.3	49.8	130.9	6	2	6	10	8	1101.382	2569.231	1105.574	498.3267	1046.811	11	1
22	13	125.5	1560.9	116.7	37.8	103.9	6	2	6	10	8	753.2785	3121.833	700.1273	378.3056	830.8103	10	3
23	11	124.5	767.4	118.7	25.0	68.8	6	2	6	10	8	746.9385	1534.746	712.1364	250	550.1414	7	4
24	14	189.1	1484.9	389.9	215.9	229.0	6	2	6	10	8	1134.468	2969.784	2339.175	2158.951	1832.278	19	-5
25	13	15.3	779.8	54.2	325.5	180.4	6	2	6	10	8	91.62175	1559.607	325.1075	3254.627	1443.313	12	1
26	13	64.3	2064.4	126.9	61.8	133.6	6	2	6	10	8	385.5862	4128.787	761.1604	617.7746	1068.847	12	1
27	9	211.6	1012.9	308.8	35.3	48.9	6	2	6	10	8	1269.391	2025.804	1852.593	352.9186	391.3557	11	-2
28	13	198.2	1815.6	349.7	79.96	212	6	2	6	10	8	1189.067	3631.211	2098.401	799.5733	1699.382	17	-4
29	12	118.8	1818	313.6	29.19	144	6	2	6	10	8	713.036	3635.949	1881.838	291.8904	1152.035	14	-2
30	13	179.9	1860.7	442.8	47.28	94.2	6	2	6	10	8	1079.402	3721.307	2656.637	472.8276	753.7192	16	-3
31	15	152.7	2848.2	533.4	104.5	242	6	2	6	10	8	915.9834	5696.404	3200.436	1045.427	1935.949	23	-8
32	11	150	948.21	107.7	29.68	67.7	6	2	6	10	8	900.0586	1896.415	645.9184	296.8011	541.5166	8	3
33	10	64.9	1115.9	125.7	104.1	113	6	2	6	10	8	389.4202	2231.762	753.9212	1040.555	906.6499	10	0
34	15	123	1082.3	241.8	86.09	158	6	2	6	10	8	738.0486	2164.654	1450.97	860.9029	1263.089	12	3
35	16	165.8	2711.6	539	70.87	216	6	2	6	10	8	995.0372	5423.117	3233.919	708.7008	1728.783	22	-6
36	11	222.6	1304	279.2	23.53	66.5	6	2	6	10	8	1335.483	2608.043	1675.135	235.3382	532.1759	11	0
37	14	35.92	1932.9	49.34	147.8	223	6	2	6	10	8	215.5349	3865.886	296.0467	1477.843	1784.675	14	0
38	12	57.43	638.52	31.97	19.29	61.1	6	2	6	10	8	344.5788	1277.036	191.8096	192.8789	488.4523	4	8
39	11	151.4	1500.5	410.8	26.43	84	6	2	6	10	8	908.2741	3000.978	2464.763	264.3159	672.3232	13	-2
40	15	182	769.99	321.9	20.69	91.8	6	2	6	10	8	1092.04	1539.975	1931.358	206.8743	734.5704	10	5
41	11	139.4	1012.7	52.61	32.44	89	6	2	6	10	8	836.1344	2025.491	315.6379	324.3864	711.9823	8	3

Source: Authors own research results.

The negative values in the difference column indicate an additional need for human resources that can be distributed from the subunits that record positive values. As a mathematical representation we can say that the number of positions calculated by this method is given by the solution of the minimum equation which determines a coefficient (k) leading to the minimization:

Min $(n_{ic}-n_{ir})^2$ provided that:

n_{ic} = k x (∑ i_i x c_j) / (∑(∑ i_i x c_j))

where N – total number of jobs

nic – the number of calculated jobs nic > 0

n_{ir} – number of existing jobs $n_{ir} > 0$

i_i – the effort indicator for each subunit

c_j – the coefficient for each indicator with ∑ c_j= 1

A third model proposed by the authors consists of using the data envelopment analysis (DEA). DEA is a nonparametric method used in operational research that is applied to empirically measure the productive efficiency of production units. It is a simple benchmarking tool and relative efficiency measurement method [20].

In this case, given the fact that we are investigating the efficiency of staff needs planning, we used an input-oriented model. The model was applied to the input variable - number of existing jobs - and used a single output variable given by the weighted sum of the performance indicators for each structure calculated similarly to the models presented above.

According to the specific data envelopment methodology it was obtained a new indicator for each subunit called technical efficiency (te_i). The number of job positions calculated using this method were determined according to the formula below:

Calculated jobs = existing jobs + (te_i - average te_i) x existing jobs.

Table 4

The aggreagation model using data envelopment

Subunit	Existing Jobs	Process Effort Indicator 1	Process Effort Indicator 2	Process Effort Indicator 3	Process Effort Indicator 4	Process Effort Indicator 5	Weight Process 1	Weight Process 2	Weight Process 3	Weight Process 4	Weight Process 5	Product Indicator x Weight 1	Product Indicator x Weight 2	Product Indicator x Weight 3	Product Indicator x Weight 4	Product Indicator x Weight 5	The Sum of the Products	TE	Calculated Jobs	Differences
1	13	150.0	1386.0	149.0	66.4	119.6	6	2	6	10	8	900	2772	894	664	957	6188	0.563	12	1
2	15	61.0	1366.2	110.0	80.1	97.5	6	2	6	10	8	366	2732	660	801	780	5339	0.416	12	3
3	11	223.2	2270.5	374.0	97.1	217.3	6	2	6	10	8	1339	4541	2244	971	1739	10834	0.789	13	-2
4	14	312.6	2182.6	159.6	50.6	168.2	6	2	6	10	8	1876	4365	958	506	1346	9050	0.678	15	-1
5	11	207.4	2193.3	306.7	88.0	250.6	6	2	6	10	8	1245	4387	1840	880	2005	10357	0.779	13	-2
6	12	26.7	738.2	114.7	28.2	136.2	6	2	6	10	8	160	1476	688	282	1089	3697	0.325	8	4
7	11	113.8	1758.8	178.3	47.5	70.9	6	2	6	10	8	683	3518	1070	475	567	6312	0.638	11	0
8	9	106.8	1108.4	128.4	44.9	68.0	6	2	6	10	8	641	2217	770	449	544	4621	0.595	9	0
9	16	128.4	1185.8	203.9	127.1	241.6	6	2	6	10	8	771	2372	1224	1271	1933	7570	0.561	15	1
10	15	142.9	1531.2	361.8	46.4	114.0	6	2	6	10	8	857	3062	2171	464	912	7466	0.582	15	0
11	14	105.2	888.0	288.5	39.3	74.5	6	2	6	10	8	631	1776	1731	393	596	5128	0.432	11	3
12	12	43.7	1021.6	41.7	25.2	52.7	6	2	6	10	8	262	2043	250	252	421	3229	0.227	7	5
13	19	124.3	2132.4	99.7	274.0	184.0	6	2	6	10	8	746	4265	598	2740	1472	9821	0.598	19	0
14	11	168.1	1994.7	251.5	177.2	255.0	6	2	6	10	8	1008	3989	1509	1772	2040	10319	0.778	13	-2
15	11	144.4	730.8	72.2	25.2	77.7	6	2	6	10	8	867	1462	433	252	622	3635	0.371	8	3
16	11	188.0	1724.8	370.2	81.4	168.8	6	2	6	10	8	1128	3450	2221	814	1350	8963	0.745	12	-1
17	12	404.9	2094.4	311.8	43.2	147.8	6	2	6	10	8	2430	4189	1871	432	1182	10103	0.753	14	-2
18	16	120.9	1986.5	262.3	69.4	156.4	6	2	6	10	8	725	3973	1574	694	1251	8217	0.595	16	0
19	10	99.4	848.8	234.7	45.2	73.8	6	2	6	10	8	596	1698	1408	452	591	4745	0.562	9	1
20	11	96.8	1698.7	189.6	25.7	94.2	6	2	6	10	8	581	3397	1138	257	754	6127	0.627	11	0
21	12	183.6	1284.6	184.3	49.8	130.9	6	2	6	10	8	1101	2569	1106	498	1047	6321	0.605	12	0
22	13	125.5	1560.9	116.7	37.8	103.9	6	2	6	10	8	753	3122	700	378	831	5784	0.533	12	1
23	11	124.5	767.4	118.7	25.0	68.8	6	2	6	10	8	747	1535	712	250	550	3794	0.397	8	3
24	14	189.1	1484.9	389.9	215.9	229.0	6	2	6	10	8	1134	2970	2339	2159	1832	10435	0.721	15	-1
25	13	15.3	779.8	54.2	325.5	180.4	6	2	6	10	8	92	1560	325	3255	1443	6674	0.595	13	0
26	13	64.3	2064.4	126.9	61.8	133.6	6	2	6	10	8	386	4129	761	618	1069	6962	0.612	13	0
27	9	211.6	1012.9	308.8	35.3	48.9	6	2	6	10	8	1269	2026	1853	353	391	5892	0.682	9	0
28	13	198.2	1815.6	349.7	80	212.4	6	2	6	10	8	1189	3631	2098	800	1699	9418	0.713	14	-1
29	12	118.8	1818	313.6	29.2	144	6	2	6	10	8	713	3636	1882	292	1152	7675	0.675	13	-1
30	13	179.9	1860.7	442.8	47.3	94.21	6	2	6	10	8	1079	3721	2657	473	754	8684	0.689	14	-1
31	15	152.7	2848.2	533.4	105	242	6	2	6	10	8	916	5696	3200	1045	1936	12794	0.756	17	-2
32	11	150	948.21	107.7	29.7	67.69	6	2	6	10	8	900	1896	646	297	542	4281	0.466	9	2
33	10	64.9	1115.9	125.7	104	113.3	6	2	6	10	8	389	2232	754	1041	907	5322	0.609	10	0
34	15	123	1082.3	241.8	86.1	157.9	6	2	6	10	8	738	2165	1451	861	1263	6478	0.519	14	1
35	16	165.8	2711.6	539	70.9	216.1	6	2	6	10	8	995	5423	3234	709	1729	12090	0.725	18	-2
36	11	222.6	1304	279.2	23.5	66.52	6	2	6	10	8	1335	2608	1675	235	532	6386	0.642	11	0
37	14	35.92	1932.9	49.34	148	223.1	6	2	6	10	8	216	3866	296	1478	1785	7640	0.619	14	0
38	12	57.43	638.52	31.97	19.3	61.06	6	2	6	10	8	345	1277	192	193	488	2495	0	5	7
39	11	151.4	1500.5	410.8	26.4	84.04	6	2	6	10	8	908	3001	2465	264	672	7311	0.687	12	-1
40	15	182	769.99	321.9	20.7	91.82	6	2	6	10	8	1092	1540	1931	207	735	5505	0.433	12	3
41	11	139.4	1012.7	52.61	32.4	89	6	2	6	10	8	836	2025	316	324	712	4214	0.457	9	2
																	AVG	0.579		

Source: Authors own research results.

In this case too, the result of the model is given by a gap between the jobs that should exist within the territorial structures (number of jobs calculated) and the jobs that could be optimized according to the data envelopment model in relation to the number of existing jobs. Consequently, for subunits with negative differences it is necessary to redistribute staff from the other subunits.

If we compare the three methods of analysis used, there is a correlation of over 85% between the three methods, indicating the convergence of analysis methods. This is true even if the correlation between the initial data and the results of each model is not correlated (the correlation coefficient is 0.39).

Table 5

Correlation analysis

	Existing Jobs	Method 1. **Scorecard**	Method 2. **Linear optimization**	Method 3. **DEA**
Existing Jobs	1			
Method 1. **Scorecard**	0.394373389	1		
Method 2. **Linear optimization**	0.375774758	0.994421654	1	
Method 3. **DEA**	0.732130826	0.856782218	0.849750149	1

Source: Authors own research results.

The conclusions that these models offer can lead to a coherent managerial decision based on a quantitative analysis support that basically consists of resizing the subunits according to the effort required to achieve the business objectives. Synthesizing the results of the three models used, decision makers can build the managerial decision as shown in table 6 below.

Table 6

Conclusions of the models used

Subunit	Existing Jobs	Method 1 Scorecard	Method 2 Linear optimization	Method 3 DEA	Conclusion
1	13	11	11	12	decrease
2	15	10	9	12	decrease
3	11	19	19	13	increase
4	14	16	16	15	increase
5	11	19	18	13	increase
6	12	7	6	8	decrease
7	11	11	11	11	no change
8	9	8	8	9	no change
9	16	14	13	15	decrease
10	15	13	13	15	decrease
11	14	9	9	11	decrease
12	12	6	5	7	decrease
13	19	18	17	19	decrease
14	11	19	18	13	increase
15	11	7	6	8	decrease
16	11	16	16	12	increase
17	12	18	18	14	increase
18	16	15	14	16	decrease
19	10	9	8	9	decrease
20	11	11	10	11	no change
21	12	11	11	12	decrease
22	13	10	10	12	decrease
23	11	7	6	8	decrease
24	14	19	18	15	increase
25	13	12	11	13	decrease
26	13	13	12	13	no change
27	9	11	10	9	no change
28	13	17	16	14	incrrease
29	12	14	13	13	increase
30	13	16	15	14	increase
31	15	23	22	17	increase
32	11	8	7	9	decrease
33	10	10	9	10	no change
34	15	12	11	14	decrease
35	16	22	21	18	increase
36	11	11	11	11	no change
37	14	14	13	14	decrease
38	12	4	4	5	decrease
39	11	13	13	12	increase
40	15	10	9	12	decrease
41	11	8	7	9	decrease

Source: Authors own research results.

The analysis from table 6 above reveals the possibility of taking a decision to optimize the number of staff in the territorial structures based on a formal analysis that takes into account autobenchmarking. The table also reveals a convergence of the solutions given by the three models, as evidenced by the covariance analysis.

The authors consider that this calculation model is useful for conducting a quick test of entities having territorial structures or branches with operations of a similar nature, especially in cases where the specific information given by the internal control system is not sufficient to carry out an in-depth analytical analysis.

Conclusions

The study presents three quantitative human resource analysis models that can be used simultaneously in organizations with a high number of staff, which have several subunits of the same type in the organizational structure and do not have a high developped internal control system. The study also provides a useful and practical tool for human resource specific control processes and redistribution of staff.

The models consist of different aggregation of effort indicators using a scorecard, a simplex algorithm and data envelopment analysis.

Analyzes can give management a real-time signal without requiring a specific human resource analysis, basically being a quick test of optimal design or resizing of human resources structures.

The research demonstrated the convergence of the three types of models in the sense of indicating the direction of reorganizing some staff structures.

The limitation of the study is given by the type of organization considered by the authors (institution with a large number of employees, homogeneous substructures and an insufficiently developed internal control system), where it is possible to develop autobenchmarking processes.

At the same time, other limitations of the study are given by the fact that the effort indicators are specific for every organization and by the fact that the data were analyzed at a single point in time.

Subsequent research directions will consist of the creation of panel data models that will include the variation in Malmquist Total Factor Productivity. The model will also include the performance indicators not only the effort indicators. Moreover, the approach will encompass the mechanism design theory for structural analysis itself.

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