HIGH PERFORMANCE MANAGEMENT: AN ILLUSTRATIVE EXAMPLE OF SALES DEPARTMENTS' PRODUCTIVITY MEASUREMENT[1]

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This paper describes a conceptual approach to measure and compare productivity of resource utilization at the firm level, adapting a set of techniques known as Data Envelopment Analysis (DEA). Within this approach, the paper addresses the issues of multiple inputs and multiple outputs of the sales departments of a firm. In particular, we focus on the resource management of sales departments. The proposed measurement methodology will allow assessment of the impact of different management policies on firm performance. It is hoped that this novel approach to productivity measurement will help sales managers identify efficient practices and superior management policies, and will promote the adoption of these policies.

1. INTRODUCTION

In the late 1990s, the American Society for Training and Development (ASTD) used the term high performance work systems to refer to "those organizations which organized workflow around key business processes and often create teams to carry out those processes" (Gephart and Van Buren, 1998). Also in the United States, the Center for Creative Leadership uses the term high

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performance work organizations (Kirkman et al., 1999), while the United Kingdom Chartered Institute of Personnel and Development refers to high performance working, emphasizing the outcome of practices in generating a differentiated product or service (Stevens, 2000). This is a topic that deserves consideration because High Performance Work Systems (HPWS) are important as they provide more efficient ways of organizing human labour, as well as they deliver higher levels of productivity and profitability.

According to Ashton and Sung (2002): *"First and foremost, stringent scientific research has now established a strong link between the use of human resource practices and enhanced performance across a range of indicators, but especially in productivity and, crucially, profitability. Put plainly, investment in these practices and the skills associated with them pays off on the bottom line"* (p.17).

Therefore, high performance management (here after HPM) raises issues regarding performance improvements. Furthermore, Wood (1999) points out the talk of high performance management or high performance work systems implies that the link between the working practices and performance has been proved.

Several authors (Farias, 1998; Goddard, 2004) support this view which is, according to Whitfield and Poole (1997): *"strongly supportive of the hypothesis that firms adopting the high-performance approach have better outcomes than those which do not"* (p. 755).

Furthermore, according to Guest (2002), there is a need of refocusing on the worker. Adding to this view, Appelbaum et al. (2000) state that: *"Studying workers' attitudes and experiences with workplace practices can help researchers get inside the black box between inputs and outputs in the production process. It can improve our understanding of the ways in which HPWS (high performance work systems) are related to performance"* (p. 110).

Therefore, managers must take a multi-project perspective, seeking to optimize the use of resources at the firm level. This is not simply a matter of optimizing activities on individual sales departments; the discretion of managers to reallocate resources among departments creates non-linear effects and, hence, sales decisions must be considered at the firm level. We claim that a measure of productivity at the departments' level has a host of benefits, as it:

- supports managers' decisions about resource utilization across departments for the most return,

- supports decisions about investment in resources,
- supports benchmarking, allowing sales departments to better understand their competitive position and improve their performance and
- supports comparative research of various management policies.

We propose in this paper that a set of non-parametric, frontier evaluation methods, known as Data Envelopment Analysis (DEA), is sufficiently powerful to accommodate the measurement challenge posed by HPM. The structure of the paper is the following. Section 2 describes the methodology's basic principles, whereas section 3 analyzes the different aspects of the methodology for HPM. Section 4 describes its applicability for measuring sales department efficiency at the firm level and section 5 imposes several research issues that must be addressed to fully adapt DEA as a HPM measurement tool. Finally, the last section concludes the paper.

2. MANAGEMENT EFFICIENCY AND DATA ENVELOPMENT ANALYSIS

Farrell (1957), in his pioneering work on productive efficiency through frontier analysis, proposed the notion of the structural efficiency of an industry. Structural efficiency is essentially an indication of the dispersion of overall efficiency among the constituent firms in an industry. It measures the extent to which an industry keeps up with the performance of its own most efficient firms. The 'Farrell' approach utilizes the classic econometric production function as its measurement base and estimates the relative level of a firm's efficiency by where it is positioned within the production "frontier." This approach enables firms to assess their relative efficiencies vis-à-vis other firms in the industry. Farrell's work and subsequent development provides a rich theoretical and methodological basis from which to develop measures of firm level performance able to address the difficulties posed by HPM.

In particular, we believe a generalization of Farrell's framework by Charnes, Cooper, and Rhodes (1978) can be adapted for use in human resource management. The Charnes, Cooper, and Rhodes (CCR) model reformulated Farrell's model as a mathematical programming approach that can accommodate multiple outputs. The CCR approach initiated the development of a broader set of non-parametric, mathematical programming efficiency measurement methods collectively known as Data Envelopment Analysis (DEA). DEA is concerned with evaluations of performance and it is especially concerned with evaluating the activities of organizations such as business firms, hospitals, government agencies, etc. In DEA, the organization under study is called a DMU (Decision Making Unit). A DMU is regarded as the entity responsible for converting inputs into outputs and whose performance is to be evaluated. DEA utilizes mathematical linear programming to determine which of the set of DMUs under study form an envelopment surface.

This envelopment surface is referred to as the empirical production function or the efficient frontier. DEA provides a comprehensive analysis of relative efficiency for multiple input-multiple output situations by evaluating each DMU and measuring its performance relative to this envelopment surface. Units that lie on the surface are deemed efficient in DEA terminology. Units that do not lie on the surface are termed inefficient and the analysis provides a measure of their relative efficiency.

For illustration, we provide the following simple example. Table 1 lists the performance of nine sales departments, each with two inputs and one output. Input x1 is the number of labor hours and input x2 is the reward payments (or bonus payments). Output y represents the volume of sales for every sales department.

Table 1. Firm level example 1

Sales Departments	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Labor hrs (x1)	4	7	8	4	2	5	6	5.5	6
Bonus payments ‘000€ (x2)	3	3	1	2	4	2	4	2.5	2.5
Sales ‘000€ (y)	1	1	1	1	1	1	1	1	1

In addition, Figure 1 plots the sales departments Input x1/Output y and Input x2/Output y as axes. From the efficiency point of view, it is natural to judge management practices that use fewer inputs to get one unit of output as more efficient. We, therefore, identify the line connecting C, D, and E as the “efficient frontier.” This frontier should touch at least one point and all points are, therefore, on or above (in this case) this line.

It should be noted that we can “envelop” all the data points within the region enclosed by the frontier line, the horizontal line passing through C and the vertical line through E. The “enveloped” region is called the “Production Possibility Set.” This means that the observed points are assumed to provide empirical evidence that production is possible at the rates specified by the coordinates of any point in the region.

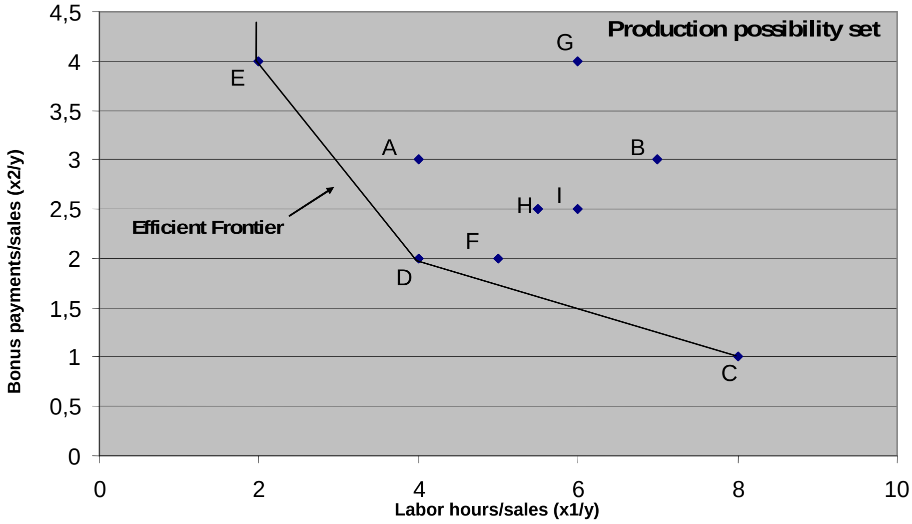

Figure 1. Firm's sales departments efficiency (example 1)

The efficiency of management practices not on the frontier can be measured by referring to the frontier point as follows. For example, department "A" is inefficient. To measure its inefficiency (see Figure 2), let OA, the line from zero to A, cross the frontier line at P. Then, the efficiency of A is to be evaluated by OP/OA = 0.8571.

This means that the inefficiency of A is to be evaluated by a combination of D and E because point P is on the line connecting these two points. D and E are called the "reference set" for A. The reference set for an inefficient department may differ from one to another. For example, B has the reference set composed of C and D in Figure 2.

Now, we extend our analysis to identify improvements by referring inefficient behaviors to the efficient frontier. From Figure 2, department A, for example, can be effectively improved by movement to P with Input x1 = 3.4 and Input x2 = 2.6. More broadly, the department can improve its efficiency by adjusting its input mix towards its reference set (D and E in this example). In the same sense, department B can be improved by movement to Q with Input x1 = 4.4 and Input x2 = 1.9.

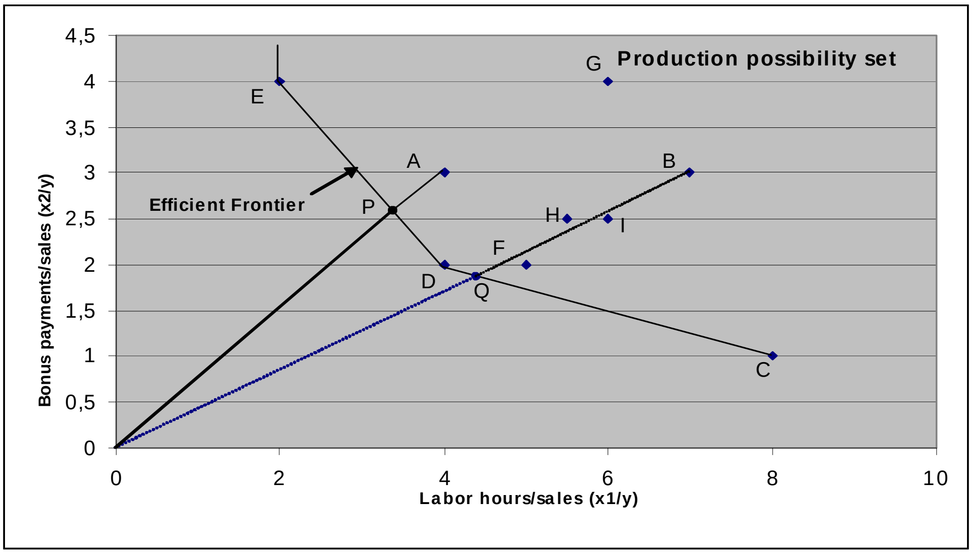

Figure 2. Efficiency of sales departments "A" and "B"

3. DEA IN MORE COMPLEX APPLICATIONS

According to several authors (Lovell and Schmidt, 1988, Seiford and Thrall, 1990; Cooper et al., 2000), DEA has opened up possibilities for use in cases which have been resistant to other parametric approaches because of the complex nature of the relations between the multiple inputs and multiple outputs involved in many of these activities.

DEA can be used for benchmarking practices without a priori assumptions. Furthermore, the weights of several inputs and several outputs are derived directly from the data, and the user is not required to assign any weights for those inputs and outputs. More importantly, DEA can easily incorporate multiple inputs and multiple-outputs. Thus, it allows the consideration of all resources used in management practices.

DEA models are either input-oriented or output-oriented. For an input-oriented projection, one seeks a projection such that the proportional reduction in inputs is maximized (i.e., by how much can input quantities be proportionally reduced without changing output quantities?). Similarly, for the output-oriented projection, one seeks a projection such that the proportional augmentation in outputs is maximized (i.e., by how much can output quantities be proportionally expanded without changing input quantities?).

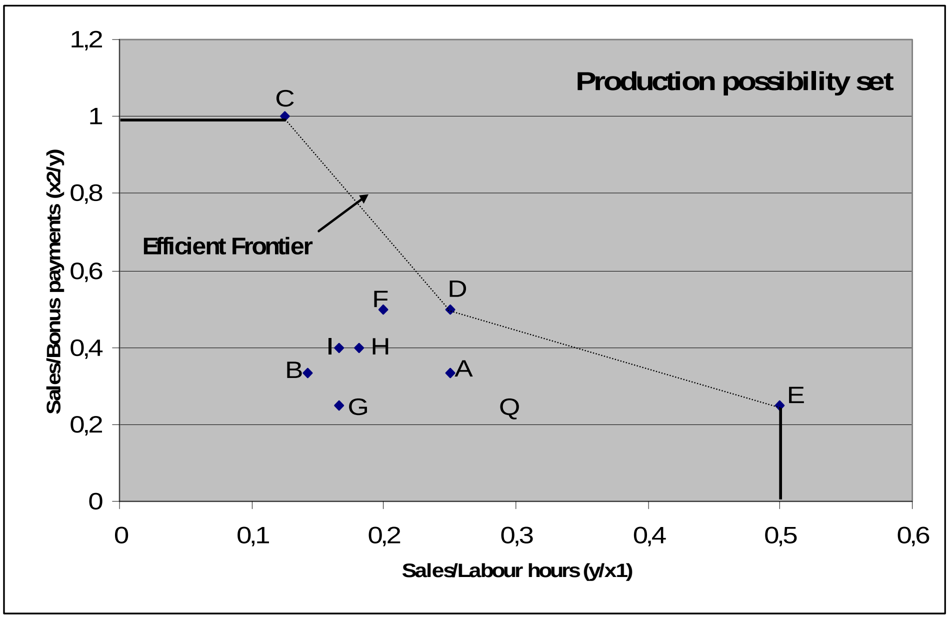

Figure 3. Output-oriented model for the sales departments (example 1)

Coelli et al. (1998) and Lovell (1993) argue that linear programming does not suffer from such statistical problems as simultaneous equation bias; the choice of an appropriate orientation is not as crucial as it is in econometric estimation. Figure 1 shows the input-oriented model for the sales departments of Example 1, while Figure 3 shows the output-oriented model for the same example. In contrast to the input-oriented model, the output-oriented model uses Output/Input1 and Output/Input2 as axes. As a result, the inefficient sales departments lie below the efficient frontier.

Additional features of DEA that make it plausible for use in the HPM lie in its ability to accommodate both categorical variables and non-discretionary variables[2].

[2] For an extensive bibliography of DEA models see Emrouznejad, (2001) and Ramanathan, (2003).

4. METHODOLOGY TO MEASURE AND COMPARE SALES DEPARTMENT PRODUCTIVITY AT THE FIRM LEVEL

In the DEA methodology, formerly developed by Charnes, Cooper and Rhodes (1978), efficiency is defined as a weighted sum of outputs to a weighted sum of inputs, where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed. In 1984, Banker, Charnes and Cooper developed a model with variable returns to scale (VRS). However, in this section, we present the CCR-model of DEA in order to demonstrate some of the technical details involved and to motivate further research. In particular, we focus on the dual of the CCR-model to measure and compare departments' productivity at the firm level. Building from the example in Section 2, we model sales departments as multiple-input, multiple-output Decision Making Units (DMUs) that attempt to minimize their inputs for given outputs. As such, our model takes an input-oriented rather than an output-oriented approach.

Suppose we have n DMUs with m input items and s output items. Let the input and output data for DMU_j be ($x_{1j}, x_{2j},\ldots\ldots\ldots., x_{mj}$) and ($y_{1j}, y_{2j},\ldots\ldots\ldots., y_{sj}$), respectively. Therefore, the input data matrix X is an (m×n) matrix and the output data matrix is an (s×n) matrix. For each DMU, we form the virtual input and output by (yet unknown) weights (v_i) and (u_r):

Virtual input = $v_1 x_1 + v_2 x_2 + \ldots\ldots\ldots\ldots + v_m x_m$
Virtual output = $u_1 y_1 + u_2 y_2 + \ldots\ldots\ldots\ldots + u_s y_s$

Given the data, we measure the efficiency of each DMU once; hence, we need n optimizations, one for each DMU_j to be evaluated. Let the DMU_j to be evaluated on any trial be designated as $DMU_\circ$ where $\circ$ ranges over 1, 2, ………., n.

In linear programming terminology, every LP has a counterpart that is called the dual. When taking the dual of a given LP, we refer to the given LP as the primal. If the primal is a maximization problem, the dual will be a minimization problem, and vice versa. The importance of the dual lies in its ability to provide additional economic insights. In our case, the dual enables us to determine all input excesses and output shortfalls. Based on the CCR-efficiency model (Charnes et al. 1978) an LP problem has been formulated with row vector **v** for inputs and row vector **u** for outputs. Both **u** and **v** are treated as variables in the following primal LP problem, which is presented in vector-matrix notation:

$$
\begin{array}{ll}
(LP^{\circ}) & \max \; uy^{\circ} \\
\text{subject to} & vx^{\circ} = 1 \\
 & -v X + u Y \leq 0 \\
 & v \geq 0, \; u \geq 0
\end{array}
$$

The dual problem of ($LP_{\circ}$) is expressed with a real variable θ and a nonnegative vector $\boldsymbol{\lambda} = (\lambda_1, \lambda_2, \ldots\ldots, \lambda n)^T$ of variables as follows:

$$
\begin{array}{ll}
(DLP^{\circ}) & \min \theta \\
\text{subject to} & \theta x^{\circ} - X\lambda \geq 0 \\
 & Y\lambda \geq y^{\circ} \\
 & \lambda \geq 0
\end{array}
$$

Table 2 shows correspondences between the primal ($LP_{\circ}$) and the dual ($DLP_{\circ}$). ($DLP_{\circ}$) has a feasible solution $\theta = 1$, $\lambda_{\circ} = 1$, $\lambda j = 0$ ($j \neq \circ$). Hence, the optimal θ denoted by θ^* is not greater than 1. To convert the above inequalities into equalities, we introduce the input excesses $\mathbf{s}^-$ and the output shortfalls $\mathbf{s}^+$ and define them as "slack" vectors.

$$
\begin{array}{ll}
(DLP_{\circ}) & \min \theta \\
\text{subject to} & \theta \mathbf{x}_{\circ} - X\boldsymbol{\lambda} - \mathbf{s}^- = 0 \\
 & Y\boldsymbol{\lambda} - \mathbf{s}^+ = \mathbf{y}_{\circ} \\
 & \boldsymbol{\lambda} \geq 0, \; \mathbf{s}^- \geq 0, \; \mathbf{s}^+ \geq 0
\end{array}
$$

Table 2. Primal and dual correspondences

Constraint ($LP_{\circ}$)	**Dual variable ($DLP_{\circ}$)**	**Constraint ($DLP_{\circ}$)**	**Primal variable ($LP_{\circ}$)**
$\mathbf{v}\mathbf{x}_{\circ} = 1$	θ	$\theta \mathbf{x}_{\circ} - X\lambda \geq 0$	$\mathbf{v} \geq 0$
$-\mathbf{v} X + \mathbf{u} Y \leq 0$	$\lambda \geq 0$	$Y\lambda \geq \mathbf{y}_{\circ}$	$\mathbf{u} \geq 0$

Source: Cooper, et al. (2000, p.44)

To discover the possible input excesses and output shortfalls, we solve the following two-phase LP problem:

$$
\begin{array}{ll}
(DLP_{\circ}) & \\
\text{Phase 1} & \min \theta \\
\text{Phase 2} & \min \; -\mathbf{s}^- - \mathbf{s}^+
\end{array}
$$

subject to
$$\theta \mathbf{x}_\circ - X\lambda - \mathbf{s}^- = 0$$
$$Y\lambda + \mathbf{s}^+ = \mathbf{y}_\circ$$
$$\theta \geq 0 \;\; \lambda \geq 0, \;\; \mathbf{s}^- \geq 0, \;\; \mathbf{s}^+ \geq 0$$

The objective of phase 2 is to find a solution that maximizes the sum of input excesses and output shortfalls while keeping $\theta = \theta^*$. An optimal solution (θ^*, $\mathbf{s}^{-*}$, $\mathbf{s}^{+*}$) of phase 2 is called the max-slack solution. If the max-slack solution satisfies $\mathbf{s}^{-*} = \mathbf{0}$ and $\mathbf{s}^{+*} = \mathbf{0}$, then it is called zero-slack.

If an optimal solution (θ^* , λ^* ,$\mathbf{s}^{-*}$, $\mathbf{s}^{+*}$) of the two LPs above satisfies θ^* =1, and is zero-slack ($\mathbf{s}^{-*}= \mathbf{0}$, $\mathbf{s}^{+*} = \mathbf{0}$), then the DMU$_\circ$ is called CCR-efficient. Otherwise, the DMU$_\circ$ is called CCR-inefficient.

For an inefficient DMU$_\circ$., we can use the following CCR projection formulas to calculate the improved input and improved output:

Improved input $\quad \mathbf{x}_\circ = \theta^* \mathbf{x}_\circ - \mathbf{s}^{-*}$
Improved output $\quad \mathbf{y}_\circ = \mathbf{y}_\circ + \mathbf{s}^{+*}$

The above two-phase LP problem is our proposed model to measure and compare sales departments' productivity at the firm level. For illustration, we utilize the departments' example after modifying the inputs of departments F and G and excluding departments H and I as shown in Table 3.

The results of this example are shown in Table 4. In the following discussion, we only explain the results of sales departments A, B, and F.

Table 3. Firm's sales departments example 2

Sales department	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Labor hrs (x1)	4	7	8	4	2	10	3
Bonus payments '000€ (x2)	3	3	1	2	4	1	7
Sales '000€ (y)	1	1	1	1	1	1	1

Table 4. Firm's sales departments example 2 results[3]

Sales department	CCR-Efficiency	Reference set	Excess		Shortfall s^+
			s_1^-	s_2^-	
A	0.8571	D, E	0	0	0
B	0.6316	C, D	0	0	0
C	1.0	C	0	0	0
D	1.0	D	0	0	0
E	1.0	E	0	0	0
F	1.0	C	2	0	0
G	0.6667	E	0	0.6667	0

4.1 Dual linear program for department A

(DLP) for A is:

$$\min \theta$$
$$\min - s_1^- - s_2^- - s^+$$
$$s.t.$$
$$4\theta - 4\lambda_A - 7\lambda_B - 8\lambda_C - 4\lambda_D - 2\lambda_E - 10\lambda_F - 3\lambda_G - s_1^- = 0$$
$$3\theta - 3\lambda_A - 3\lambda_B - \lambda_C - 2\lambda_D - 4\lambda_E - \lambda_F - 7\lambda_G - s_2^- = 0$$
$$\lambda_A + \lambda_B + \lambda_C + \lambda_D + \lambda_E + \lambda_F + \lambda_G - s^+ = 1$$

(all variables are nonnegative)

The optimal solution for $(DLP)_A$ is:

$$\theta^* = 0.8571$$
$$\lambda_D^* = 0.7143, \ \lambda_E^* = 0.2857, \ other \ \lambda_j^* = 0$$
$$s_1^{-*} = s_2^{-*} = s^{+*} = 0$$
$$v_1^* = 0.1429, \ v_2^* = 0.1429, \ u_1^* = 0.8571$$
$$\theta^* = 0.8571 < 1$$

Therefore, department A is inefficient. Since $\lambda^*_D > 0$ and $\lambda^*_E > 0$, the reference set for A is $E_A = \{D, E\}$. $\lambda^*_D = 0.7143$ and $\lambda^*_E = 0.2857$ show the proportions contributed by D and E to the point used to evaluate A. As we

[3] Results were obtained using the DEA-Solver software (Cooper et al., 2000).

mentioned earlier, department A can be brought to the efficient frontier by using the CCR-projection formulas.

Improved input 1 of department A:

$A = \theta^* x_1 - s_1^{-*} = 0.8571\ (4) - 0 = 3.42$ labor hrs (14.5% reduction).

Improved input 2 of department A:

$A = \theta^* x_2 - s_2^{-*} = 0.8571\ (3) - 0 = 2.57$ bonus payment (14.5% reduction).

Improved output:

$y + s^{+*} = 1 + 0 = 1$ (no change)

The same results are achieved using $\lambda^*_D = 0.7143$ and $\lambda^*_E = 0.2857$ as follows:

Improved input 1 of department A :

$$\lambda_D^* * input\ 1\ of\ D + \lambda_E^* * input\ 1\ of\ E$$
$$= 0.7143 * 4 + 0.2857 * 2 = 3.42\ \ labor\ hrs$$

Improved input 2 of department A:

$$\lambda_D^* * input\ 2\ of\ D + \lambda_E^* * input\ 2\ of\ E$$
$$= 0.7143 * 2 + 0.2857 * 4 = 2.57\ \ labor\ hrs$$

Again, we can obtain the same results by utilizing the input weights ($v_1^* = 0.1429$ and $v_2^* = 0.1429$) and the output weight ($u^* = 0.8571$).

$v_1^*\ x_1 = (0.1429)\ (4) = 0.58$, therefore the improved input = 4 - 0.58 = 3.42.

$v_2^*\ x_2 = (0.1429)\ (3) = 0.43$. The improved input = 3 – 0.43 = 2.57.

4.2 Dual linear program for department B

(DLP) for B is:

$$\min \theta$$
$$\min - s_1^- - s_2^- - s^+$$
$$st$$
$$7\theta - 4\lambda_A - 7\lambda_B - 8\lambda_C - 4\lambda_D - 2\lambda_E - 10\lambda_F - 3\lambda_G - s_1^- = 0$$
$$3\theta - 3\lambda_A - 3\lambda_B - \lambda_C - 2\lambda_D - 4\lambda_E - \lambda_F - 7\lambda_G - s_2^- = 0$$
$$\lambda_A + \lambda_B + \lambda_C + \lambda_D + \lambda_E + \lambda_F + \lambda_G - s^+ = 1$$

(all variables are nonnegative)

The optimal solution for $(DLP)_B$ is:

$$\theta^* = 0.6316$$
$$\lambda_C^* = 0.1053,\ \lambda_D^* = 0.8947,\ other\ \lambda_j^* = 0$$
$$s_1^{-*} = s_2^{-*} = s^{+*} = 0$$
$$v_1^* = 0.1429,\ v_2^* = 0.1429,\ u_1^* = 0.8571$$
$$\theta^* = 0.6316 < 1$$

Therefore, department A is inefficient. Since $\lambda^*_C > 0$ and $\lambda^*_D > 0$, the reference set for B is $E_B = \{C, D\}$.

Improved input 1 of department B:

$B = \theta^* x_1 - s_1^{-*} = 0.6316\ (7) - 0 = 4.42$ labor hrs (36.8% reduction).

Improved input 2 of department B:

$B = \theta^* x_2 - s_2^{-*} = 0.6316\ (3) - 0 = 1.89$ bonus payment (36.8% reduction).

Improved output:

$y + s^{+*} = 1 + 0 = 1$ (no change).

4.3 Dual linear program for department F

(DLP) for F is:

$$
\begin{aligned}
&\min \theta \\
&\min - s_1^- - s_2^- - s^+ \\
&st \\
&10\theta - 4\lambda_A - 7\lambda_B - 8\lambda_C - 4\lambda_D - 2\lambda_E - 10\lambda_F - 3\lambda_G - s_1^- = 0 \\
&\theta - 3\lambda_A - 3\lambda_B - \lambda_C - 2\lambda_D - 4\lambda_E - \lambda_F - 7\lambda_G - s_2^- = 0 \\
&\lambda_A + \lambda_B + \lambda_C + \lambda_D + \lambda_E + \lambda_F + \lambda_G - s^+ = 1
\end{aligned}
$$

(all variables are nonnegative)

The optimal solution for $(DLP)_F$ is:

$$
\begin{aligned}
&\theta^* = 1 \\
&\lambda_C^* = 1, \ \textit{other } \lambda_j^* = 0 \\
&s_1^{-*} = 2, \ s_2^{-*} = s^{+*} = 0
\end{aligned}
$$

Therefore, department F is inefficient. Since $\lambda^*_C > 0$, the reference set for F is $E_F = \{C\}$. Improved input 1 of department F:

$F = \theta^* x_1 - s_1^{-*} = 1 \ (10) - 2 = 8$ labor hrs (20% reduction).

Improved input 2 of department F:

$F = \theta^* x_2 - s_2^{-*} = 1 \ (1) - 0 = 1$ bonus payment (no change).

Improved output:

$y + s^{+*} = 1 + 0 = 1$ (no change).

From Table 4, departments C, D, and E have $\theta^* = 1$, and $s_1^{-*} = s_2^{-*} = s^{+*} = 0$. These departments satisfy $\theta^* = 1$ and the zero-slack ($\mathbf{s}^{-*} = \mathbf{0}$, $\mathbf{s}^{+*} = \mathbf{0}$) criteria, and are therefore claimed CCR-efficient.

5. RESEARCH CHALLENGES

In the preceding sections, we presented two trivial examples to introduce the basic idea behind the DEA terminology and the CCR-model. However, both examples are far from depicting the complexity faced when measuring productivity at the firm level. Adopting DEA is not straight forward, but rather complicated. The following discussion addresses three issues that should be resolved before DEA can be implemented for firm level productivity measurement.

Level of detail for data collection

Data can be aggregated at various levels. Two questions arise: (1) At which level should data be collected to facilitate reliable comparison? (2) At which level can data be collected efficiently? Further investigation is required to answer the fore-mentioned questions before DEA can be successfully applied in HPM.

Required transformations

A basic requirement for productivity comparison across departments is the consistency of units. Collected data may require simple transformations so that the productivity of sales departments doing a variety of work can be expressed in terms of an equivalent output of a single standard item. (While DEA can accommodate multiple outputs, it is unreasonable to expect that all possible outputs will be included in the analysis, and there must be some consolidation of data.) Thus, the productivity of all departments can be calculated for the same standard item during each time period, regardless of the work performed.

Inputs and outputs

Which inputs and outputs should be accounted for in the CCR-model? As Stigler (1976, p. 213-214) has observed, measured inefficiency may be a reflection of a failure to incorporate the right variables and the right constraints and to specify the right economic objective of the production unit.

6. CONCLUSION

This paper presents a Data Envelopment Analysis methodology as an approach of HPM by measuring and comparing sales departments' productivity at the firm level. DEA is an empirical, non-parametric approach to productivity measurement that can be extended to multiple inputs (resources) and multiple outputs (products). It is specifically designed to compare productivity between firms (decision-making units or DMUs), ranking them against a frontier defined by the most productive firm(s). DEA appears well-suited to measuring the productivity of sales departments. The multi-input capabilities of DEA allow the comparison of firms' efficiency employing all their resources. The multi-output capabilities of DEA allow the inclusion of the different types of products performed by a firm (products and services); this allows comparison at the firm level to determine not just relative efficiency but also policy questions such as 'what are the best management practices?' The determination of a frontier provides not just a relative comparison among firms but also an absolute measure that can be used to measure productivity changes over time. DEA appears to have the requisite power and flexibility to be employed in HPM; however, further research is needed to allow effective pre-processing of data for analysis using DEA methods.

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MENADŽMENT VISOKIH PERFORMANSI: ILUSTRATIVNI PRIMJER MJERENJA PRODUKTIVNOSTI PRODAJNOG ODJELA

Sažetak

Ovaj članak opisuje konceptualni pristup mjerenju i uspoređivanju produktivnosti korištenja resursa na razini poduzeća, koristeći prilagođeni skup tehnika Data Envelopment Analysis (DEA). Korištenjem ovog pristupa, članak se bavi problemom višestrukih inputa i outputa prodajnih odjela. Posebna se pažnja obraća menadžmentu resursa odjela za prodaju. Predložena metodologija mjerenja omogućava procjenu utjecaja različitih menadžerskih politika na performanse poduzeća. Očekuje se da će ovakav, novi pristup mjerenju produktivnosti pomoći menadžerima prodaje, kao i menadžerima viših razina, u identificiranju učinkovitih politika i unaprijediti njihovo prihvaćanje.