

# Effective and Efficient Tools in Human Resources Management Control

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## Abstract

*The main objective of our study is to select the most important quantitative techniques that may be applied as tools in human resources management control, in order to facilitate the prediction of human resource indicators that may be presented under an appropriate form, clear and user friendly and then used by managers in their decision making process. Therefore, we have analysed the regression analysis and the learning curves, tools that are considered appropriate in human resources management control. The cases presented in our research form part of our cooperation projects with different companies, projects aiming to improve and sustain an efficient human resources management control.*

**Key words:** *human resources, regression analysis, learning curves, balanced scorecard for human resources*

**JEL Classification:** *M41*

## Introduction

A company uses many resources such as financial, natural or human resources (HR). The most important of all, for a company, is still the human resource and this is because without it, it would be impossible to accomplish the mission or to attain a specific vision within a company.

The capital theory (Becker and Schultz, 1964) considers the employees as assets that may be valued based on their competences. Human resources are the most important capital of a company – the vital contact with customers – the key for success (Tom Farmer, 2010).

Waterman recognized that the organization – people, culture, capacity – represents an important source of competitive advantages. People are the strategy (Waterman, 1994, p. 21-22). The increase in financial performances of a company is due to the good implementation of a human resources strategy, the Knowledge Management.

The importance attributed to human resources is revealed by the seven principles of total quality management. The sixth principle of the TQM stipulates that: people are the organization's primary resource and these resources execute the organization's processes. Machines are tools and contribute to the productivity of people. However, they have no meaning without people to figure out how to use them in concert with one another to create the company's outputs.

The concept of sustainable development (SD) and the concept of corporate social responsibility (CSR) have a major influence over the way that HR is managed. For example, in the case of SD,

considering the priority of values, the natural resources come first, followed by humanity saving. On the contrary, CSR concept considers that the management priority must be given to HR, followed by the life standards. HR is associated with values such as: ethics, engagement for a long period of time, interrelationship between internal and external actors, objectives etc. Consequently, the balanced scorecard proposed in our research is based on these concepts and the indicators are linked to priorities.

## Quantitative Techniques in Human Resources Forecasting

In the specialised literature, we encounter two groups of techniques for human resources forecasting: qualitative techniques and quantitative techniques (Sutanto, 2000).

Qualitative techniques are based on the subjective opinion of the forecaster. Quantitative techniques are based on mathematical modelling, being used when the quantitative data is available.

### Regression Analysis

In order to prepare a balanced scorecard for the presentation of certain indicators needed by the management it is necessary to compare forecasts against real amounts. To emphasize better the objective of our research we shall calculate the predetermined and real indicators for the human resource. We consider the application of the regression analysis as a worthy solution in forecasting, because we want to prove the interrelationship between two variables selected for human resources, e.g. total cost and training expenses. Based on these two variables we want to calculate the influence of training expenses on the total cost for a certain level of training expenses. This will be a first effect, because another will influence the quantity and the quality of goods or services produced by the company.

Regression analysis is a forecasting method based on historical data meant to find the best fit between two variables – one dependent on the other, and use the straight line to predict future values. The equation of a straight line is:

$$y = ax + b \quad (1)$$

where:

**a** is the gradient or slope

**b** is the intercept with the y axis

**n** is the sample size.

On the horizontal axis we have the independent variable – *training expenses*, and the dependent variable, *y*, is located on the vertical axis – *total cost*.

The formulae applied to calculate **a** and **b**, are the following:

$$a = (n \sum xy - \sum x \sum y) / (n \sum x^2 - (\sum x)^2) \quad (2)$$

$$b = \sum y / n - a \sum x / n \quad (3)$$

Supposing we have, the following data, for a small company, for a period of six months:

Table 1. Example

Month	Training expenses (mu)	Total cost (mu)
April	2,000	34,000
May	4,000	33,000
June	5,000	33,000
July	3,000	31,000
August	1,000	30,000
September	2,000	30,000

We want to compute the total cost, if training expenses will be mu 6,000.

To forecast costs, when training expenses are known, we must calculate the following elements:

**Table 2.** Calculation using the regression analysis

Month	X	Y	XY	X <sup>2</sup>	Y <sup>2</sup>
April	2	34	68	4	4,624
May	4	33	132	16	17,424
June	5	33	165	25	27,225
July	3	31	93	9	8,649
August	1	30	30	1	900
September	2	30	60	4	3,600
<b>Total</b>	<b>17</b>	<b>191</b>	<b>548</b>	<b>59</b>	<b>62,422</b>

$$a = (6*548-17*191)/(6*59-17^2) = 0.63$$

$$b = 191/6-0.63*17/6 = 33.58$$

When training expenditure is zero, costs will be mu 33,585, and for every mu 1 spent on training, costs will increase by mu 0.63. If training expenses will be mu 6,000, the total cost will be:

$$Y = ax + b = 0.63*6 + 33,585 = 33,589$$

For forecasting costs for any level of training expenses, the equation of straight line shall be used. Also for all costs related to human resources, regression analysis may be used as a relevant tool.

If we want to show the strength of the linear relationship between the two variables, we can achieve this by calculating the correlation coefficient (r):

$$r = (n \sum xy - \sum x \sum y) / \sqrt{(n \sum x^2 - (\sum x)^2)(n \sum y^2 - (\sum y)^2)} \quad (4)$$

The correlation coefficient may have values within the interval [-1; +1]. The interpretation of this instrument may be as follows:

- r is close to +1: there is a strong positive correlation between the two variables;
- r is close to -1: there is a strong negative correlation between the two variables;
- r is close to 0: there is a weak relationship between the two variables.

For our example r will be:

$$r = (6*548-17*191)/(6*59-17^2)(6*62,442-191^2) = 0.0087$$

r is close to 0 meaning that between training expenses and total cost is a weak relationship, due to the small amount of training expenses in total cost. For small companies, the budget meant for personnel training is not as important as for big companies, where the relationship between variables is strong positive.

## Learning Curves

Estimates are forecasts of our expectations based on past conditions and on all changes predicted for the future. A relevant example may be the learning curves as an application of non-linear equations.

The changes that occur in the economic, social, cultural environment, as well as the increase in the competition have to determine the change at the entity's level for survival.

Adapting the organization means continuous learning. At the level of each working place, the increase in productivity can be achieved through better methods and instruments, but also through individual learning. Through learning, repeating, the worker fulfills his tasks more efficiently which results in a reduction in the direct labour hours per unit of product.

Yet, at the individual level, learning is affected by many factors: individual ability, individual variability, financial incentives, organizational norms and constraints, training, and the nature of the social environment (Uzumeri and Nembhard, 1998).

The learning effect is represented by a curve called the learning curve, emphasizing the report between the direct labour force per unit and the total quantity of a product or service.

Managers need to know all about the time needed to produce a number of units of output, especially for new products that the company intends to launch on the market. In this case experiences show that learning is more rapid in the first periods, and after that, the learning rate decreases gradually until the realization of a certain number of products or jobs, when time becomes a constant (the Bell curve).

Why is it important to calculate the learning curves effect? The answer is a simple one, because there is always a link between the number of hours needed to produce an expected number of products or to realize a number of specific jobs and the number of human resources employed for this reason. The number of persons that is required for all tasks must be remunerated and their salaries and wages influence the costs per unit of output, the total cost and the efficiency. If the learning curves effect is calculated, it is possible to determine how productivity increases and consequently how to decrease the cost per unit.

In conclusion, the effect of learning curves is declining in average time and in average cost per unit.

Wrights Law states the following: as cumulative output doubles, the cumulative average time per unit falls to a fixed percentage (the learning rate) of the previous average time (Lucey, 2001, p. 167).

When the curve becomes horizontal, the learning effect is lost and production time per unit becomes a constant.

The effect of learning curves can be calculated using two *methods*:

1. cumulative average time method;
2. marginal method.

Both methods use the same general formula, although they have different manners of defining the elements.

The learning curve is a non-linear function and the formula used is:

$$Y = ax^b \quad (5)$$

where:

a – time taken to produce the first unit or batch;

b – learning coefficient;

x – cumulative output expressed in units or in batches.

The definition of Y is different from one method to the other. For example, for a cumulative average time method, Y is cumulative average time per object, for x objects, while for a marginal method, Y is the marginal time for object x.

### 1. Cumulative average time method

It involves the preparation of a table where the average time is reduced by the learning rate each time the output doubles.

Researchers have demonstrated that the trend is to decrease the time it takes to produce an object at a constant rate equal to the rate at which the output increases. For example, a 90% learning curve shows that, as cumulative total output doubles, the cumulative average time to produce one object decreases to 10%.

The example that will be presented is based on the data provided by a small manufacturing company that intends to launch a new product. They asked us to calculate the total time needed for the production of sixteen batches, when the learning curve was anticipated at 90%.

The data we used in order to make the calculation is the following:

**Table 3.** Calculation using cumulative average time method

Cumulative number of batches	Cumulative average time per batch (hours)	Cumulative total hours
(1)	(2)	(3) = (1)*(2)
1	200	200
2	180 (200*90%)	360
4	162 (180*90%)	648
8	145.5 (162*90%)	1,166.4
16	131.22 (145.5*90%)	2,099.52

The last figure of this table 131.22 and is not the time needed to produce the sixteenth batch. If we want to calculate this time, two *steps* must be performed:

**Step 1.** Calculate the average time for the fifteenth batch and cumulative average time to produce 15 batches;

**Step 2.** Calculate the time for sixteenth batch as a difference between cumulative total hours for 16 batches and cumulative average time to produce 15 batches.

**Step 1.** General relation:

$$Y = ax^b \quad (6)$$

$$b = \log(1-\text{proportional decrease})/\log 2 = \log(1-0.1)/\log 2 = \log 0.9/\log 2 = -0.1520$$

$$a = 200; x = 15$$

$$y = 200 \cdot 15^{-0.152} = 132.5 \text{ hours} - \text{average time for batch no. 15}$$

$$\text{Cumulative average time to produce fifteen batches} = 132.5 \cdot 15 = 1,987.5 \text{ hours}$$

$$\text{Step 2. Time for the sixteenth batch} = 2,099.52 - 1,987.5 = 112.02 \text{ hours}$$

## 2. Marginal method

The basic assumption in a marginal method is: the time needed to produce a marginal unit of a batch will be reduced with a given fixed percentage when the cumulative output doubles.

Using the same example, the illustration of a marginal learning curve, for a 90% rate, will be:

**Table 4.** Calculation using the marginal method

Cumulative number of batches	Cumulative average time per marginal batch (hours)	Cumulative total hours
(1)	(2)	(3)=(1)*(2)
1	200	200
2	180	360
4	162	?
8	145.5	?
16	131.22	?

In this table, figures are the same as in Table 3, but the significance is different. So that, the numbers of column 2 (200, 180, 162, 145.8, 131.22) represent the number of hours used to produce batches number 1, 2, 3, 4,...,16, and not the average hours to produce the first batch, the second, the third,..., because we do not have the marginal time needed to produce batches number 3, 5, 6, 7, 9,...,15. To calculate these values the formula is:  $Y=ax^b$ , where Y is the time

to produce the marginal batch (unit), and is used to calculate the time to produce the sixteenth batch. The *steps* are the following:

- To calculate the time for batch nr. 16:  $Y = 200 \cdot 16^{-0.152} = 131.22$  hours
- To compute the cumulative time for cumulative number of batches (16).

It is impossible to calculate directly this time. In order to find out this value we will calculate for each batch from 1 to 16, and the sum of those durations will be the answer of our question.

Time to produce batch no 3 =  $200 \cdot 3^{-0.152} = 169.2$  hours

Time to produce batch no 5 =  $200 \cdot 5^{-0.152} = 156.6$  hours

Time to produce batch no 6 =  $200 \cdot 6^{-0.152} = 152.32$  hours

Time to produce batch no 7 =  $200 \cdot 7^{-0.152} = 148.7$  hours

Time to produce batch no 9 =  $200 \cdot 9^{-0.152} = 143.2$  hours

Time to produce batch no 10 =  $200 \cdot 10^{-0.152} = 140.94$  hours

Time to produce batch no 11 =  $200 \cdot 11^{-0.152} = 138.9$  hours

Time to produce batch no 12 =  $200 \cdot 12^{-0.152} = 137.08$  hours

Time to produce batch no 13 =  $200 \cdot 13^{-0.152} = 135.43$  hours

Time to produce batch no 14 =  $200 \cdot 14^{-0.152} = 133.9$  hours

Time to produce batch no 15 =  $200 \cdot 15^{-0.152} = 132.5$  hours

Total time calculation =  $200 + 180 + 169.2 + 162 + 156.6 + 152.32 + 148.7 + 145.8 + 143.2 + 140.94 + 138.9 + 137.08 + 135.43 + 133.9 + 132.5 + 131.22 = 2,407.79$  hours.

After the comparison between the two methods, several *conclusions* can be drawn:

- The general formula was the same, but the results were different because Y was interpreted in different manners.
- Total time for sixteen batches was by method 1: 2,099 hours and by method 2: 2,407.79 hours. A difference of 308.79 was calculated, due to the reduction of production time for each unit of output, in the marginal method.
- Learning curves are not equivalent for two different methods.
- Because results are so different, it is important to select carefully what method to apply. In our opinion, the first method is appropriate because it is simple and the cost-benefit relation will be a favourable one.
- The number of predetermined hours once calculated, will be the starting point for determining the number of employees needed to achieve the target output as well as salaries and wages, as an important part of the total cost.

The learning curves are used at the level of the organizations where exists a dependency of the labour force quality and less at the level of the ones in which the dependency aims the performance of the available equipments.

The procedures changes, at the personnel level, in projecting the products generate the change of the learning curves on a short term.

The managers use learning curves as planning instruments. To use these curves, an estimation of the learning rate has to be realized, rate that depends on several factors (for instance, the product's complexity). We have to consider the decrease in the direct labour hours by introducing equipments that replace the direct work. The assessment of the learning rate is sometimes difficult and based on experience. The learning curves differ at the level of branch and enterprise. The industry averages for the learning curves can be used, but we should consider that each company is unique, having labour force capable to obtain advantages.

## Balanced Scorecard for Human Resources

A balanced scorecard (BSC) is a performance measurement and reporting system that strikes a balance between financial and nonfinancial measures, links performance to rewards, and gives explicit recognition to the diversity of organizational goals (Horngren et al., 2008).

BSC is an important tool for managers because they may understand the effect of their actions on the nonfinancial and financial indicators, allowing them to analyse how the company attained its goals, for a certain period, as part of a long term strategy.

Generally, a BSC is prepared for the company as a whole, but we propose a BSC only for the human resources, because we consider this resource as for being vulnerable and it must be treated accordingly.

A BSC for human resources (HRBSC) may include indicators grouped in four axes:

- Economic axis;
- Life quality axis;
- Ethical axis;
- Societal and environmental axis.

and may be presented as follows:

**Table 5.** HRBSC indicators

<p><b>Economic</b></p> <p>Total employees</p> <p>Shares allocated to employees (% in total equity)</p> <p>Revenue per employee</p> <p>Average cost per employee</p> <p>Cost of HR function per employee</p> <p>% of cost reduction due to learning curves</p> <p>Productivity (sales revenue/direct labour hours)</p> <p>% of training cost in total cost or in sales</p> <p>% reduction in process cycle time</p>	<p><b>Life quality</b></p> <p>Working conditions</p> <p>Working hours</p> <p>Working accidents (%)</p> <p>Illness time</p> <p>Part time employees</p> <p>Access to services (transport, kindergarten)</p> <p>Employees implication in management</p> <p>Qualification and autonomy</p> <p>Training days per employee</p> <p>Leadership competence</p> <p>Negotiation capacity</p>
<p><b>Ethic</b></p> <p>Average salary/sector salary</p> <p>Women salaries</p> <p>Men salaries</p> <p>Number of handicap employees</p> <p>Average salary per handicap person</p> <p>Women managers</p> <p>% of internal rules respected</p>	<p><b>Societal and environmental</b></p> <p>Number of employees implicated in external actions</p> <p>HR policy in respect with the environment</p> <p>Number of employees participating to humanitarian actions</p> <p>Tutorial hours for young employees</p>

This HRBSC contains indicators for: human effectiveness; employment; competences; motivation; that in our opinion, are enough to analyse the contribution of HR to the global performance.

From another point of view, indicators may be used to manage a corporate social responsibility, because they may measure human resource performance, based on four axes, both internal and external, so that all kind of analysis are possible.

Indicators presented in HRBSC must be calculated as predetermined figures versus real figure, facilitating the calculation of variances, the identification of causes leading to differences and, respectively, the decision making process on how to eliminate the causes that influence performance.

## Conclusions

1. HR strategy is influenced by SD and CSR.
2. HR strategy is contributing to the increase of global performance of a company.
3. The concept of HR is linked to human capital.
4. To forecast HR indicators quantitative techniques are the best solution.
5. All kind of costs related to HR may be treated as independent variables in relation with a dependent variable.
6. We have calculated only the effect of training expenses, in order to prove that a strong relationship exists, if the amount is a relevant one.
7. To calculate the effect of the learning curves is something important from two points of view: first of all because productivity increases, and secondly because the cost per unit of object decreases. These are important when the number of employees and total salary costs are calculated.
8. HRBSC proposed by this research is different from the classical content of a BSC, where the four axes are: financial, process, customers and competence.

## Acknowledgement

This work was supported by CNCSIS – UEFISCDI, project number PNII – IDEI 1858/2008 “Management Control in the Sustainable Development of the Human Resources”.

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## Instrumente eficiente și practice în controlul de gestiune al resurselor umane

## Rezumat

*Obiectivul principal al studiului nostru este acela de a selecta cele mai importante tehnici cantitative ce pot fi utilizate ca instrumente în controlul de gestiune al resurselor umane, în scopul de a face previziuni privind indicatorii aplicabili resurselor umane. Acești indicatori vor putea fi apoi prezentati sub o formă adekvată, clară și ușor de utilizat, ca - în cele din urmă - să fie utilizati în procesul de luare a deciziilor de către manageri. Din acest motiv, am utilizat analiza de regresie și graficul de învățare, instrumente care sunt considerate adecvate în domeniul controlului de gestiune al resurselor umane. Cazurile prezentate în cercetarea noastră fac parte din proiecte de colaborare pe care le avem cu diferite companii, proiecte ce vizează să îmbunătățească și să susțină în mod eficient controlul de gestiune al resurselor umane.*

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