# CONTRIBUTION OF E-LEARNING IN COMPANY PRODUCTIVITY

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## 1 INTRODUCTION

In the knowledge society, human resources must have updated knowledge in order to face the highly competitive markets. So, to improve productivity it is crucial that human resources have an appropriate education and training for the performance of their jobs. Competitiveness and sustainable development are related with the capacity of getting information, to transform it into knowledge and to distribute it throughout the company in order to promote the human resources knowledge.

E-learning is an application of computer science based on information technologies and Internet that allows the individual to have an effective control on the contents, the learning process, and the goals to reach. These factors in conjunction with the low transportation cost optimise the economic investments in training.

In fact, e-learning is a powerful tool that allows achieving the objectives of training and education in the company. It is available on Internet at any time, and everywhere not only for the acquisition of knowledge but also for changing ideas. It is basically the combination of two strategic factors: (1) training / education and (2) use of new technologies.

The objectives of e-learning are divided in three great groups: (1) productivity enhancement; (2) quality improvement and (3) costs savings.

The cost benefit analysis identifies and measures the beneficial results from a training program. Benefits come in two types: (1) tangible benefits are those that can be measured such as a sales training program increased sales by 5 percent or a customer service program increased customer satisfaction survey results by 10 percent. (2) Intangible benefits that can be measured indirectly, for instance improvements in teamwork resulting from training or less stress among employees who complete the maintenance training course.

Brandon Hall (1998) conducted an exhaustive research on e-learning, in the area of return on investment and concluded that “50 percent reduction in time and cost over classroom training”.

E-learning allows in real time the information dissemination on the company products and services, besides the specific training. Consequently, the company profits in terms of time, costs and employee presence in the workplace.

## 2 OBJECTIVE AND METHODOLOGY

The objective of this paper is to analyze and evaluate the relationship between e-learning versus quality and productivity. The methodology used in this investigation was based on an inquiry composed of twenty questions and made to thirty-seven companies that are using e-learning. These enterprises are large, medium and small scale, located throughout Portugal and belonging to four service sectors [National Institute of Statistics, 2000].

The Likert scale with five levels, from 1=never to 5=always, was used in order to measure each manager's assessment of the strategies pursued by his company. The market research commenced with validation of the survey questionnaire by a panel composed by ten leading managers from companies.

The statistical software package SPSS 11.0 was used to analyze the survey response database. The statistical methods applied were as follows:

- Descriptive analysis: to determine the frequency and percentage of variables that identify companies, as well as the mean value, standard deviation, maximum and minimum values of the seven strategic factors under consideration;
- Bivariate analysis, namely the Chi-square test: to evaluate whether the survey responses given by companies about the seven strategic factors are dependent or independent of activity, scale, location and head-office nationality of companies;
- Multivariate analysis:
  - Cluster analysis: to determine homogenous groups, whereby each element of a group is more similar to the other elements of this group than to the elements of any other group;
  - One-way analysis of variance: to check whether there are significant differences within the groups identified via cluster analysis and to characterise each group.

The following sections identify the survey implementation, sample identification, determination of the cause-effect relationship between the seven strategic factors and classification of companies. The research intends to identify groups of companies that share comparable strategies as far as e-learning and its relation with quality and productivity is concerned.

## 3 SURVEY IMPLEMENTATION AND SAMPLE CHARACTERISATION

200 survey questionnaires were sent by post to companies located in Portugal. We received 42 surveys, but only 37 were valid, once 5 were rejected due to several missing values.

The company's identification - activity, scale, location in Portugal and head office nationality - is outlined in the Figure 1.

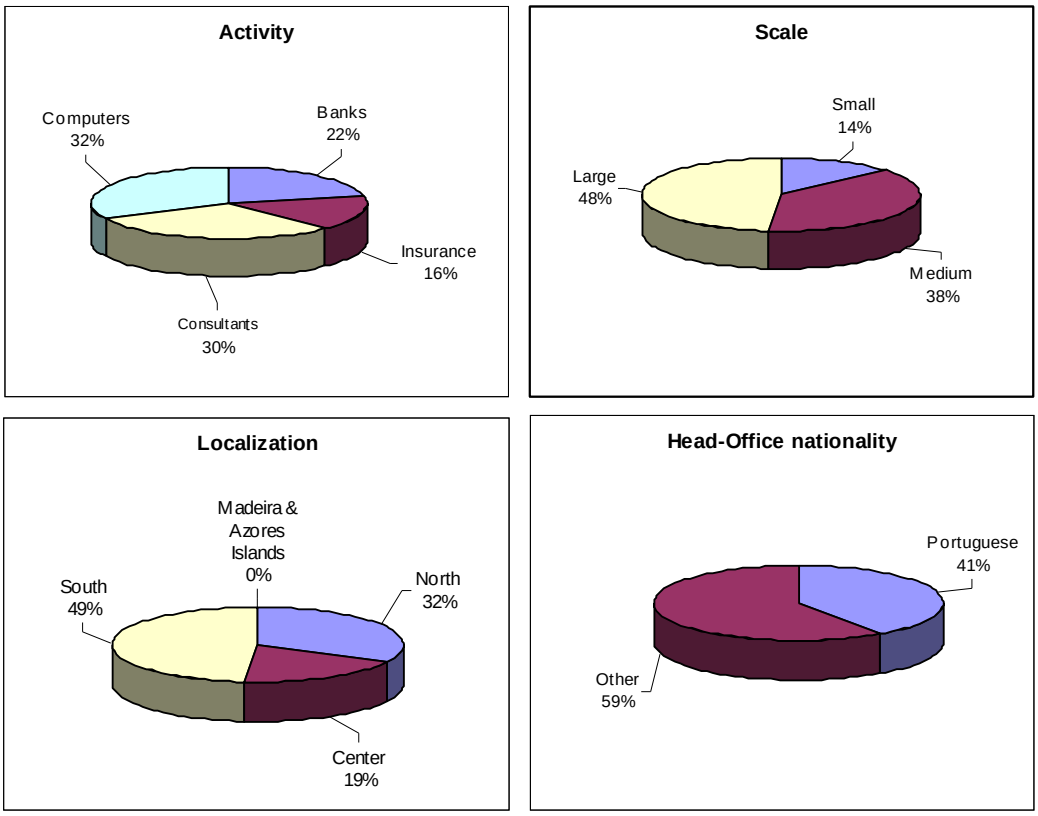


Figure 1 - Activity, scale, location and head-office nationality of companies.

The mean value, standard deviation, maximum and minimum values of the seven strategic factors are presented in Table 1 below.

| Factors | Mean Value | Standard Deviation | Min. | Max. |
|---|---|---|---|---|
| 1 E-learning increases productivity | 4.2 | 0.52 | 1 | 5 |
| 2 E-learning increases production volume | 4.1 | 0.82 | 1 | 5 |
| 3 E-learning decreases the time for the task execution | 4.3 | 0.82 | 1 | 5 |
| 4 E-learning increases the performance quality level | 3.9 | 0.92 | 2 | 5 |
| 5 E-learning decreases employees turnover | 3.1 | 1.01 | 1 | 5 |
| 6 E-learning decreases the absenteeism | 2.9 | 0.71 | 1 | 5 |
| 7 E-learning increases the employees motivation | 3.6 | 0.84 | 1 | 5 |

Table 1 - Mean, standard deviation, minimum and maximum values of the factors.

The highest mean value ($x_m$) was obtained in Factor 3 “E-learning decreases the time for the task execution” ($x_m$=4.3) and the lowest mean value in Factor 6 “E-learning decreases the absenteeism” ($x_m$=2.9). The answer to the Factor 1 “E-learning increases productivity” is the most consensual (s=0.52) and to the Factor 5 “E-learning decreases employees turnover” is less consensual (s=1.01).

The frequency percentage for each of the seven strategic factors is shown in Table 2.

| Factors | Nothing 1 | Little 2 | Reasonably 3 | Much 4 | Strongly 5 |
|---|---|---|---|---|---|
| 1 E-learning increases productivity | 5,4% | 5,4% | 16,2% | 43,2% | 29,7% |
| 2 E-learning increases production volume | 2,7% | 2,7% | 10,8% | 48,6% | 35,1% |
| 3 E-learning decreases the time for the task execution | 2,7% | 5,4% | 13,5% | 45,9% | 32,4% |
| 4 E-learning increases the performance quality level | 0,0% | 13,5% | 21,6% | 43,2% | 21,6% |
| 5 E-learning decreases employees turnover | 10,8% | 16,2% | 37,8% | 24,3% | 10,8% |
| 6 E-learning decreases the absenteeism | 13,5% | 21,6% | 37,8% | 18,9% | 8,1% |
| 7 E-learning increases the employees motivation | 5,4% | 8,1% | 29,7% | 37,8% | 18,9% |

Table 2 - Frequency percentage per strategic factor.

The highest percentage value was 48.6% obtained in level 4 of Factor 2 “E-learning increases production volume”. The lowest percentage of 0% occurred in Factor 4 “E-learning increases the performance quality level” in level 1.

## 4 RELATIONSHIP BETWEEN COMPANY CHARACTERISATION AND SURVEY RESPONSES

To determine whether a company strategy is dependent or independent of the identification variables (activity, scale, location and head office nationality), the Chi-square test was used.

The Chi-square test compares observed and expected frequencies of two variables of the sample and checks whether it is possible to accept the hypothesis of independence between these variables within the population. The null hypothesis $H_0$ is tested against the alternative $H_a$.

$H_0$: variables are independent  $H_a$: variables are not independent

To test the independence of variables, the T statistic equation (1) is used.

$$T = \sum_{i=1}^{n} \frac{\left(F_{oi} - F_{ei}\right)^2}{F_{ei}} \qquad (1)$$

Where: $F_{ei}$: expected frequency, when the null hypothesis is verified for category (i); $F_{oi}$: observed frequency for category (i) of each variable; ($F_{oi}$ - $F_{ei}$): difference between the observed and the expected frequency for the crosstab (i).

Comparison between Pearson and alpha significances, makes it is possible to accept or reject the null hypothesis. If Pearson significance is less than 5% there are no reasons to accept the null hypothesis [Newbold 1995].

In Table 3 the results and conclusions of the Chi-square test applied to factors and demographic variables are shown.

| Factors | Activity | | Scale | | Location | | Head Office | |
|---|---|---|---|---|---|---|---|---|
| | Pearson Signif. | Conclusion | Pearson Signif. | Conclusion | Pearson Signif. | Conclusion | Pearson Signif. | Conclusion |
| 1 E-learning increases productivity | 0.001 | Dep. | 0.145 | Indep. | 0.245 | Indep. | 0.001 | Dep. |
| 2 E-learning increases production volume | 0.010 | Dep. | 0.821 | Indep. | 0.662 | Indep. | 0.002 | Dep. |
| 3 E-learning decreases the time for the task execution | 0.094 | Indep. | 0.740 | Indep. | 0.631 | Indep. | 0.094 | Indep. |
| 4 E-learning increases the performance quality level | 0.671 | Indep. | 0.662 | Indep. | 0.501 | Indep. | 0.099 | Indep. |
| 5 E-learning decreases employees turnover | 0.003 | Dep. | 0.002 | Dep. | 0.023 | Dep. | 0.602 | Indep. |
| 6 E-learning decreases the absenteeism | 0.040 | Dep. | 0.175 | Indep. | 0.821 | Indep. | 0.775 | Indep. |
| 7 E-learning increases the employees motivation | 0.023 | Dep. | 0.000 | Dep. | 0.123 | Indep. | 0.084 | Indep. |

Table 3 - Relationship between factors and company identification variables.

The opinions expressed in Factor 3 “E-learning decreases the time for the task execution” and in Factor 4 “E-learning increases the performance quality level” are independent on companies activity, scale, location and head office.
However, the opinions given to Factor 5 “E-learning decreases employees turnover” are dependent on activity, scale and location of companies.
Table 4 reveals that the answers to questions are independent of location 86%, scale 71% and head-office nationality 71%.

| Identification Variable | Dependent Factor | Independent Factor |
|---|---|---|
| Activity | 71% | 29% |
| Scale | 29% | 71% |
| Location | 14% | 86% |
| Head-office nationality | 29% | 71% |

Table 4 - Percentage of dependent / independent responses.

## 5 DETERMINATION OF GROUPS

Cluster analysis was used in order to identify groups of companies sharing relatively homogeneous environmental strategies [Sarmento 1997]. On this basis, companies within any one group are implementing similar strategies, distinct from those used by companies belonging to other groups.

The cluster analysis used, attempts to identify groups of companies based on seven strategic factors, using a specific algorithm.

We can conclude that division into four groups is the appropriate solution, using the Ward method and squared Euclidean distance. This solution can be validated using one-way analysis of variance and confirmed through the discriminative analysis. This analysis demonstrates that 100% of assembled companies are correctly classified in the four groups. Each strategic group has the following number of companies:
Group 1: 8 companies; Group 2: 16 companies; Group 3: 9 companies; Group 4: 4 companies.

The one-way analysis of variance tests the hypothesis of equal means amongst the groups. If the mean values of the groups are equal, then the groups are not different in respect to the seven strategic factors.

All the preconditions required and steps concerning this analysis, including the Levene and F test were accomplished, whereby we can conclude that there are four different groups. The mean values of the factors for each group are displayed in Table 5. Group 4 presents the

| **Factors** | **1** | **Group 2** | **Group 3** | **Group 4** | **Total** |
|---|---|---|---|---|---|
| | 8 Cases | 16 Cases | 9 Cases | 4 Cases | 37 Cases |
| | 22% | 43% | 24% | 11% | 100% |
| 1 E-learning increases productivity | 3.3 | 4.5 | 4.9 | 4.1 | 4.2 |
| 2 E-learning increases production volume | 3.5 | 3.6 | 4.9 | 4.5 | 4.1 |
| 3 E-learning decreases the time for the task execution | 4.8 | 3.6 | 4.3 | 4.6 | 4.3 |
| 4 E-learning increases the performance quality level | 4.7 | 3.0 | 4.2 | 4.2 | 3.9 |
| 5 E-learning decreases employees turnover | 2.5 | 1.6 | 3.4 | 5.0 | 3.1 |
| 6 E-learning decreases the absenteeism | 1.2 | 1.6 | 3.8 | 5.0 | 2.9 |
| 7 E-learning increases the employees motivation | 2.8 | 4.4 | 3.1 | 4.2 | 3.6 |
| Mean Value | 3.6 | 3.5 | 4.1 | 4.6 | 3.9 |

Table 5 - Mean values of factors for each group.

- Factors 1 and 2 have the maximum mean value at group 3 and the minimum in groups 1 and 2 respectively.
- Factors 3 and 4 have the maximum mean value at group 1 and the minimum at group 2. Factors 5 and 6 have the maximum mean value at group 4 and the minimum in groups 2 and 1 respectively.
- Factor 7 has the maximum mean value at group 2 and the minimum at group 1.

Table 6 shows the composition in percentage of each group as far as the activity, scale, location and head-office nationality of companies are concerned.

| **Identification Characteristics of Companies** | | **Group 1** 8 Comp. 22% $x_m$=3.6 | **Group 2** 16 Comp. 43% $x_m$=3.5 | **Group 3** 9 Comp. 24% $x_m$=4.1 | **Group 4** 4 Comp. 11% $x_m$=4.6 | **Total** 37 Comp. 100.0% $x_m$=3.9 |
|---|---|---|---|---|---|---|
| Activity | Computers | | 44% | 56% | | 32% |
| | Consultants | 50% | 19% | 44% | | 30% |
| | Banks | 50% | | | 100% | 22% |
| | Insurance | | 38% | | | 16% |
| Scale | Large enterprise | 50% | 19% | 78% | 100% | 48% |
| | Medium enterprise | 50% | 56% | 11% | | 38% |
| | Small enterprise | | 25% | 11% | | 14% |
| Location | North of Portugal | 50% | 31% | 33% | | 32% |
| | Centre of Portugal | | 31% | 22% | | 19% |
| | South of Portugal | 50% | 38% | 44% | 100% | 49% |
| | Madeira & Azores Isl. | 0% | 0% | 0% | 0% | 0% |
| Head-office Nationality | Portuguese | 50% | 38% | 33% | 50% | 41% |
| | Other country | 50% | 63% | 67% | 50% | 59% |

Table 6 - Identification characteristics of companies for each group

## 6 CHARACTERISATION OF THE STRATEGIC GROUPS

As showed in previous section, the service industries under investigation can be aggregated into four strategic groups. Each group has distinct approach in relation to e-learning versus quality and productivity.

The groups' characterization was based on Scheffé test, F test and mean values of the seven factors.

– Group 1:

Characteristics: This group of companies represents 22% of the sample. It includes companies pertaining to two industrial activities, whereby consultant companies represent 50% of the group and banks 50%. Large and medium-scale enterprises represent 100% of the group. 50% of companies are located in the centre and south of Portugal and 50% are foreign companies.

E-learning conclusions: This group has a mean value of $x_m$=3.6, denoting that companies moderately consider that e-learning is a critical factor for the increasing of productivity regarding the seven strategic factors. The companies pertaining to this group consider strongly that e-learning decreases the time for the task execution ($x_m$=4.8) and increases

the performance quality level ($x_m$=4.7). These companies assume that e-learning increases production volume ($x_m$=3.5) and productivity ($x_m$=3.3). Sometimes they think that e-learning increases the employees motivation ($x_m$=2.8) and decreases employees turnover ($x_m$=2.5). However e-learning rarely decrease the absenteeism ($x_m$=1.5).

- Group 2:

  Characteristics: This group of industries is the largest of the sample representing 43%. Among the four groups, this has the highest percentage of computer companies 44%, of medium scale enterprises 56% and of industries located in the south of Portugal 38%. Foreign companies represent 63% of the group.

  E-learning conclusions: This group has a mean value of $x_m$=3.5, expressing a moderate concern in the seven strategic factors. The companies belonging to this group strongly consider that e-learning increases productivity ($x_m$=4.5) and employees motivation ($x_m$=4.4). E-learning increases moderately the production volume ($x_m$=3.6) and the performance quality level ($x_m$=3.0). However e-learning decreases employees turnover ($x_m$=1.6) and absenteeism. ($x_m$=1.2).

- Group 3:

  Characteristics: This group of industries represents 24% of the total sample. Of all groups, this has the highest percentage of computer companies 56%, large-scale enterprises 78%, located south of Portugal 44%. The companies are 67% foreign.

  E-learning conclusions: Group 3 has a mean value of $x_m$=4.1 which means that companies demonstrate a great interest in the seven factors under investigation. The companies pertaining to this group highly consider that e-learning increases productivity ($x_m$=4.9), production volume ($x_m$=4.9), performance quality level ($x_m$=4.2) and decreases the task execution time ($x_m$=4.3). These companies moderately believe that e-learning decreases the absenteeism ($x_m$=3.8), employees turnover ($x_m$=3.4), and increases motivation ($x_m$=3.1).

- Group 4:

  Characteristics: This group of companies is the smallest representing 11% of the sample. 100% are large banks located in the south of Portugal. The companies are half Portuguese and half foreign.

  E-learning conclusions: This group has the highest overall mean value of $x_m$=4.6 expressing a profile with a profound interest in the seven strategic factors. They strongly think that e-

learning decreases employees turnover ($x_m$=5.0), absenteeism ($x_m$=5.0), and task execution time ($x_m$=4.6). On the other hand, e-learning increases production volume ($x_m$=4.5), performance quality level ($x_m$=4.2), productivity ($x_m$=4.1) and employees motivation ($x_m$=4.2). The companies involved in this research highly consider that e-learning is a critical factor for productivity regarding the seven strategic factors ($x_m$=3.9).

In conclusion, the data analysis reveals that most companies consider that investing in training, especially e-learning will increase the productivity and performance quality level.

For Groups 3 and 4 e-learning increases productivity and production volume. For Groups 1 and 4 e-learning is essential for increasing performance quality level and reduce task execution time. Group 4 assumes that employees turn over and absenteeism is strongly reduced due to e-learning. Indeed, Group 2 and 4 emphasise that employees motivation is highly enhanced through e-learning. Nevertheless, companies are in general considering that e-learning is a critical factor for increasing productivity.

On the basis of our knowledge of the sector and interviews with top managers, it is possible to conclude that in Portugal e-learning (and traditional learning) matters are better than they were a decade ago. The success of the implementation of the e-learning in companies will improve quality and productivity levels and consequently will enhance profit and customer satisfaction (employees and clients).

## 7 CONCLUSIONS

The main purpose of the research presented in this paper is to analyse the relationship between e-learning versus quality and productivity. Strategic profiles of service industries were studied on the basis of seven strategic factors and four company's identification variables.

This work was based on a survey carried out between January and April, 2002. 37 valid answers were processed using the statistical software package SPSS 11.0.

During the presentation of the statistical results some conclusions were already mentioned. The research reveals that companies consider e-learning a critical factor for increasing productivity and quality, given that for the factors "e-learning increases productivity" and "e-learning increases production volume" mean values were $x_m$=4.2 and $x_m$=4.1 respectively.

This research identifies that there are four organised groups that consider e-learning a critical factor for competitiveness with independent strategic profile and behaviour:

- Group 2, 3 and 4 representing 78% of the sample assume that e-learning highly increase productivity and production volume ($x_m$>4.0).
- Groups 1, 3 and 4, representing 57% of the sample, say that e-learning highly decreases the time for the task execution and increases the performance quality level ($x_m$>4.3).
- The companies belonging to Group 4 strongly consider that e-learning decreases employees turnover and absenteeism ($x_m$=5.0).

- Groups 2 and 4, representing 54% of the total, stress their employees motivation is due to e-learning.

The managers' e-learning strategies are dependent on the company's activity in 71%. Nevertheless 86% e-learning strategies are independent of company's location.

The competitiveness of the companies is related with its intellectual capital. E-learning consolidates and transforms knowledge into competitive advantages. In fact, collaborators with better and updated information are crucial for the company sustainable development that competes in an exigent world always in constant mutation.

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