WHAT TO USE? TECHNOLOGICAL OR TRADITIONAL TOOLS FOR DOCUMENTS' CORRECTION?. THE STUDENTS DECIDE

Zein Kallas

Universitat Politècnica de Catalunya, Departament d'Enginyeria Agroalimentària i Biotecnologia, Projecte RIMA (Recerca i Innovació en Metodologies d'Aprenentatge) GIUM-A research Group in Moodle-Atenea (SPAIN)

E-mails [zein.kallas@upc.edu]

Abstract

Technology plays an important role in the classroom as unavoidable tools supposed to help teachers in developing their activities. By Technology we refer to the capabilities, given by the practical application of knowledge, in carrying out their subjects a) more efficiently, b) more precisely and c) more thoroughly. In this work, students' acceptance for the "voice correction" tools in evaluating their works was analyzed. In this context, this new tool has been compared to a) the "traditional" correction method of printed document and c) the "track change" tool of text processors. A structured questionnaire was designed and answered by 57 students of the agricultural technical engineering career using the web 2.0 application of "Google Form". The Analytical Hierarchy Process (AHP) is used to assess students' relative preference for the above-mentioned three correction tools. We used a pair wise comparison approach where in a first step the students had to indicate which of the two correction tools prefers. Then a nine point scale is used to measure the strength of this preference by means of verbal judgments using a 9 point scale. Results show a high preference toward the "voice" correction tool obtaining a 42.02% of relative preference, followed by the "track change" with 33.02% and the traditional printed document by 24.95%. To complement our research, "technical difficulty" faced by student in using the voice correction tool have been analyzed by a Logit regression. Results show that male students with low average qualification who do not have smartphone with internet connection are prone to face difficulties in using this technology.

Keywords: Innovation, correction tools, web 2.0, Analytical Hierarch y Process.

1 INTRODUCTION

Information and communication technology (ICT) is changing modes of learning, collaboration and expression [1]. In teaching their basic role is to help teachers to improve the development of their subjects in an efficient and precise way. In this context, a radical rethinking of the use of the technology in education by teachers is needed as a mean of a continuous improvement of the transmitted information for students [2]. Among this technology, the Web 2.0 tools are of great help in developing educational activities and a way to involve student in different task. From the different resources on the web, we highlights the relevant tools used for presentations (Mindomo for mental maps, Prezi, etc.), for collaborating (Google applications such as documents, calendar, and sites, etc.), for storage and sharing (Dropbox and syncplycity, etc.) and for participation (Blogs, Wikipedia, etc.). Amongst these applications we comment the Voxopop tool presented as a voice based e-learning approach. It is rely on message boards but using voice rather than text. The obtained recorded voices files can be shared between individuals in three ways: public, semi-private (do need an account) and private (need voxpop account). However, this application suffers from the restriction of including audio files in other soft wares such as the text processors.

The idea behind this work is to use teacher recorded voice in the task of correcting documents. This may allow a better explanation of knowledge in a more efficient way. In this line, a text processor is needed that allow inserting voice within the document. To my knowledge, there are no web 2.0 tools that may facilitate this requirement. For instance, the Google Docs tool does not allow (yet) introducing voice within its text processor. However, some free software such as the Open Office allow for it. Moreover, the word office software allows introducing audio file or recorded voice within the text of a document. Thus, the main objective of this paper is to analyze students' acceptance for the "audio or voice correction” tools in evaluating their works by introducing the teachers voice with the text. In addition, we seek to compare this correction tool with the “traditional” correction method of printed document and with the “track change” tool of text processor. We have decided to use the office word text processor as it is the used in our university and to be the only available in students’ computers. However, as commented, the open office software can do also the some function.

2 METHODOLOGY

As mentioned before, the main objective of this study is to analyze the students' acceptance of a new correction tool. To achieve this aim, two specific objectives have been identified. The first one focus on analyzing the “relative importance” of the “voice tool” compared to the “traditional correction” one (writing on printed document) and to the “track change tool” of a text processor. The second objective tries to analyze factors affecting the perception of difficulties that students faced in using it. To reach the objectives different techniques have been proposed. Table 1 summarizes the applied methods.

Table 1: the Methodological framework

Technique applied	***Objectives***
The Analytical Hierarchy Process- AHP	Relative importance of correction tools according to student’s opinion
The Logistic regression	Factors affecting difficulty faced in using the voice correction tools

Follows we explain each of the used technique in this study.

2.1 The Analytical Hierarchy Process- AHP

The AHP is a mathematical technique for multi-criteria decision-supporting method in discrete environments ([3] and [4]). It enables decision makers in their planning, setting priorities, selecting the best product among a set of them, and allocating resources. It aims to decompose a complex decision problem in a hierarchy of smaller constituent sub-problems. Thus, determining the individually most preferred alternative from a set of elements is a decision problem where the hierarchy top level represents the individual elements (Figure 1).

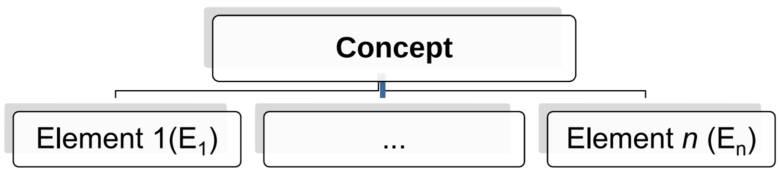

Figure 1: Hierarchy of elements

In order to implement the AHP, alternatives should be compared in order to set the best and preferred one. Thus, one needs to carry out a survey where individuals are asked to make a pairwise comparison between elements. First, the respondent has to indicate which of the two elements the respondent prefers. Then a nine point scale is used to measure the strength of this preference by means of verbal judgments as can be seen in Table 2.

Table 2: The AHP comparison scale

Importance rating	***Definition of the scale***
1	Two characteristics are equally important
2	Between 1 and 3
3	The preferred characteristics are slightly more important
4	Between 3 and 5
5	The preferred characteristics are moderately more important
6	Between 5 and 7
7	The preferred characteristics are strongly more important
8	Between 7 and 9

9	The preferred characteristics are absolutely more important

From the answers provided, a matrix with the following structure is generated for each individual k and is known as the Saaty matrix:

$$S_k = \begin{bmatrix} a_{11k} & a_{12k} & \cdots & a_{1jk} \\ a_{21k} & a_{22k} & \cdots & a_{2jk} \\ \cdots & \cdots & a_{ijk} & \cdots \\ a_{i1k} & a_{i2k} & \cdots & a_{NNk} \end{bmatrix} \qquad (1)$$

where a_{ijk} represents the value obtained from the pairwise comparison between element *i* ($i \in N$ / $i \in P$) and element *j*; ($j \in N$ / $j \in P$) for each individual k. The fundamental properties of this comparison matrix are: a) reciprocal comparison: if $a_{ijk}=x$ then $a_{jik}=1/x$); b) homogeneity: if element *i* and *j* are judged to be of equal relative importance then, $a_{ijk} = a_{jik} = 1$; and c) all the elements of its main diagonal take a value of one ($a_{iik}=1 \; \forall \; i$).

If perfect consistency in preferences holds for each decision-maker, it should also hold that $a_{ihk} \times a_{hjk} = a_{ijk}$ for all *i*, *j* and *h* ($h \in N$ / $h \in P$). This condition implies that values given for pairwise comparisons represent weights given to each element by a perfectly rational decision-maker $a_{ijk}= w_{ik}/w_{jk}$ for all *i* and *j*. Therefore, the Saaty matrix can also be expressed as follows:

$$S_k = \begin{bmatrix} \frac{w_{1k}}{w_{1k}} & \frac{w_{1k}}{w_{2k}} & \cdots & \frac{w_{1k}}{w_{Nk}} \\ \frac{w_{2k}}{w_{1k}} & \frac{w_{2k}}{w_{2k}} & \cdots & \frac{w_{2k}}{w_{Nk}} \\ \cdots & \cdots & \frac{w_{ik}}{w_{jk}} & \cdots \\ \frac{w_{Nk}}{w_{1k}} & \frac{w_{Nk}}{w_{2k}} & \cdots & \frac{w_{Nk}}{w_{Nk}} \end{bmatrix} \qquad (2)$$

Under such circumstances, K weights (w_{Nk}) for each element (N) can be easily determined from the N(N-1)/2 values for a_{ijk}. However, perfect consistency is seldom present in reality, where personal subjectivity plays an important role in the pairwise comparison. Thus in the case of perfect consistency it should hold that: $S_k \times W = N \times W$ (for elements) where $W =(w_1, w_2, \ldots, w_N)$. However, in Saaty matrixes ($S_k=a_{ijk}$) some degree of inconsistency is present. Therefore, Saaty proposed the redefinition:

$S_k \times W= \lambda_{max} \times W$, where λ_{max} is the maximum eigenvalue of matrix S_k which is determined by:

$$\lambda_{\max} = \sum_i \sum_j \hat{a}_{ijk} \hat{w}_{ik} \qquad (3)$$

Saaty proved that $\lambda_{max} \geq N$ (element) enables one to test the degree of inconsistency in respondent ratings. Thus the quantity $\lambda_{max} - N$ measures the degree of inconsistency within the S_k. In this context, Saaty proposes the Consistency Index (CI):

$$CI = \frac{\lambda_{max} - N}{N-1} \qquad (4)$$

[2] defined the Consistency Ratio as CR=CI/RI where RI is a Random Index which denotes the CI for a randomly generated S_k matrix as can be seen in Table 3. Values of CR ≤ 0.1 are acceptable and higher value respondents are asked to revise their pairwise comparison

Table 3: RI values

n	1	2	3	4	5	6	7	8	9	10
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

In Saaty matrices where some degree of inconsistency is present, alternative approaches have been proposed to estimate the weight vector that is better able to represent the decision-maker's real weight vector. [3] and [5] proposed two options as the accurate estimate of real weights: the geometric mean and the main eigenvector. Other authors have proposed alternatives based on regression analysis ([6]) or goal programming ([7]). As all criteria meet the requirements to estimate the above-mentioned weights, we choose the geometric mean ([8] and [9]). Using this approach, weights assigned by subject to each attribute and level are obtained using the following expression:

$$\lambda_{\max} = \sum_i \sum_j \widehat{a}_{ijk} \widehat{w}_{ik} \quad (5)$$

AHP was originally conceived for individual decision-making, but was rapidly extended as a valid technique for the analysis of group decisions ([10]). We aggregate corresponding individual weights (w_{ik}) across subjects to obtain a synthesis of weights for each element (w_i). The geometric mean can be used in the aggregation process for the whole sample ([11]) as follows:

$$w_i = \sqrt[K]{\prod_{k=1}^{k=K} w_{ik}} \qquad \forall\, i \quad (6)$$

2.2 The Logistic regression

The purpose of the logistic regression is to obtain a multiple regression model with the following characteristics:

a) The response variable (Y) is discrete, usually binary: true (1) or false (0).

b) The explanatory variables can be both quantitative and categorical.

c) The starting model is not linear but exponential, but with the logit transformation is represented as linear.

Logit models are a basic tool for analyzing problems of different kinds. In this sense, it highlights their use in biomedical studies (especially studies answer yes / no treatment). In this line, the acceptance (1) or not (0) of the students of the voice correction tool fits perfectly in the same regression models. For this reason the logistic model has been considered in this paper to analyze this response variable (Y).

The Logistic regression tries to express the probability p_i to accept the voice correction tool according to the following exponential model:

$$p_i = \frac{e^{x_i' \cdot \beta}}{1 + e^{x_i' \cdot \beta}} \quad (7)$$

This model is called logistic distribution, where $x_i' = [1, X_{1i}, X_{2i}, ..., X_{ki}]$ represents the profile of cases *i* in the explanatory variables X_j and $\beta' = [\beta_0, \beta_1, ..., \beta_k]$ is the vector of coefficients to be estimated through the regression.

If we make the ratio of the odds that a student accepts or not the voice tool, i.e. the number of times it is more likely that a student with particular characteristics accept or not the proposed correction tool, it would be easy to obtain that:

$$\frac{p_i}{1-p_i} = e^{x_i' \cdot \beta} \quad (8)$$

Now, taking logarithms, we get the common logistic regression model:

$$\ln\left(\frac{p_i}{1-p_i}\right) = x_i' \cdot \beta \quad (9)$$

Where the expression:

$$\ln\left(\frac{p_i}{1-p_i}\right) \quad (10)$$

is called logit transformation of p_i.

Thus, logistic regression models the logit of the probability of occurrence of a success in the response variable (Y = 1, i.e. the acceptance of the voice tools) as a linear function of the explanatory variables. In this same context, it is relevant to mention that the linear logistic function given by $\beta_0 + \beta_1 \cdot X_{1i} + \beta_2 \cdot X_{2i} + ... + \beta_k \cdot X_{ki}$, does not provide the probability (p_i) to accept the new tool of correction, but its logit, i. e., the logarithm of the number of times that a student with a characteristics $[X_{1i}, \cdot X_{2i}, ..., X_{ki}]$ is more likely to accept the tool in front of not accepting it.

In the logistic equation, as in any linear model, the coefficients β_l are interpreted as the change (increase or decrease) of the response variable (logit of p_i) that could cause a unit increase in the explanatory variable X_i.. A clearer interpretation would be obtained by taking exponential for the elimination of the logit transformation. So we get the so-called *odds ratio* (OR). Thus, the OR of the i^{th} explanatory variable is defined as:

$$OR_i = e^{\beta_i} \quad (11)$$

In this case, it is easy to check that the odds ratio expresses the change that originates in the quotient $\left(\frac{p_i}{1-p_i}\right)$ a unit change in the considered explanatory variable, i.e. increasing or decreasing the probability of accepting the new voice correction tools.

For more detailed information on this type of regression technique, the interested reader can consult [12] among others authors.

3 THE EMPIRICAL APPLICATION

The data used in this analysis was obtained from a survey using a structured questionnaire in classes with students. We used the Google Form option to ensure students anonymity allowing them to comment freely their opinions and concerns. The questionnaires were carried out during April 2011. Each questionnaire solicits information on student's characteristics and their opinion toward the different correction tools. The final sample consists of 57 students of agro-food market subject in their second year of the agricultural engineering grade.[1].

It is worth mentioning that before carrying out the survey, students have already experiment the voice correction tools as it was used to correct some document in a work group's task. To insert a voice comment, only we need a microphone and earphones. The process starts by inserting an object (from the insert menu) and continue by selecting the option of voice file. In a subsequent step, we choose the "new file" option and we start to record our voice comment within the document for one minute as limiting time for each inserted audio file.

[1] The questionnaire used can be found at: https://docs.google.com/spreadsheet/formResponse?hl=ca&formkey=dHAwT0dpQ2MwNE5RRWtjUnZMSTgybHc6MQ&ifq

3.1 The AHP Application

For the AHP application a pair wise comparison exercise is needed in order to obtain judgments that estimate the relative importance for each alternative at individual level (student) as well at the whole sample. The pair wise comparison used in our questionnaire can be shown in Table 4.

Table 4: Example of the AHP questions

The "voice correction" tools									The "traditional" correction of printed document							
9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
The "voice correction" tools									The "Track change" tool of text processor							
9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
The "traditional" correction of printed document									The "Track change" tool of text processor							
9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9

In your opinion, what is the most important element that determines your preference for rabbit meat? Indicate the degree of superiority of the preferred element. In case of equality of items, select the option "1".

3.2 The Logistic regression application

For the logistic regression, the dependent variable (y) used was the technical difficulty that faced student in using the "voice correction" tool. This variable was initially created using an 11 point Likert scale (from 0 to 10) where 0 is "did not face any technical difficulty" and 10 is "I face several technical difficulties". In order to adapt this scale for a logistic regression, we have created a dummy variable that take the value of "0" if for the scale value from 0 to 5 (26.3% of the responses) and take the value of "1" if the scale value is from 6 to 10 (73.7% of the responses).

The explanatory variables proposed for the realization of the logistic model were:

- ***IDEA***: What did you think of the idea of correcting a survey through an voice option?
- ***GEND***: Gender of the student
- ***LAP***: Do you have a laptop?
- ***PC***: Do you have a desktop computer?
- ***SMRT***: Do you have a smartphone or similar with Internet connection?
- ***AVRG***: What is the average grade you usually get in the courses?

The inclusion of these variables has been done using the *stepwise* selection method. Thus, the proposed model is: Y = f (ID, GEND, LAP, PC, SMRT, AVRG). More specifically, the mathematical expression to be adjusted with the logistic regression is:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 \cdot IDEA_i + \beta_2 \cdot GEND_i + \beta_3 \cdot LAP_i + \beta_4 \cdot PC_i + \beta_5 \cdot SMRT_i + \beta_6 \cdot AVRG_i$$

4 RESULTS

Results demonstrate that the idea of the voice correction has been positively perceived by students with an average valuation of (8.58). However, they stated that they faced technical difficulty in hearing the corrections (7.04). This is because some of the desktop computers in the University (for Students) do not contain "sound card hardware" and therefore it was impossible for students to realise this task in the University since the task requires the presence of all the member of the group. In addition, using their personal computer was also in some cases difficult as they need to use in a public space. In this context students were asked to mention 3 main advantages and three main disadvantages of the "voice correction". Results are summarized in the Table 5.

Table 5: Advantages and disadvantages of the “voice correction tool” as stated by students

Disadvantages	***Advantages***
▪ You cannot get a piece of the recording, but you have to hear all of it. ▪ Obligation to have headphones or speakers. ▪ If you're in a public place and do not have headphones, you can annoy other people. ▪ Could not stop the recording. ▪ File Size. ▪ In some cases you should write corrections on a paper if are numerous. ▪ is less comfortable ▪ Problems in compatibility of versions for the text processor.	▪ The corrections are clearer. ▪ It is a quick and easy way to understand what should be corrected. ▪ You can edit the document while listening to the voice. ▪ It is Fast, clear and concise. ▪ It is a useful and innovative method. ▪ You do not need to print the corrections. ▪ You have always the corrections for the future. ▪ It is a more ecological method. ▪ Allows the teacher to better express his ideas. ▪ It is closer to student. It's more like a face to face correction. ▪ Allow for much information in little time.

4.1 Results of AHP

Results allow us to identify the relative importance of the three alternatives of corrections. Figure 2 shows a graphical illustration of the obtained weights.

As can be seen, the proposed “voice correction” tool was the most preferred for students with a weight of 42.02% compared to the other alternatives (24.95% for the traditional correction and 33.023% for the track change). This result confirms the acceptance that receives the voice correction tool as a new method adapted to student’s concerns. They stated that their preference is toward tools that allow them to feel closer to teacher and obtain concise and better information in correction within a few part of time.

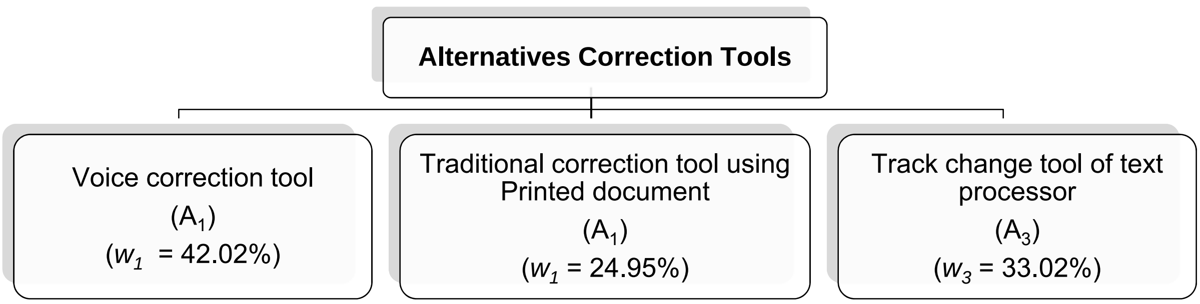

Figure 2: The relative importance of alternatives tools of corrections to be valuated

4.2 Results of the Logistic regression

In analyzing the factors that affect technical difficulties faced by students when using the voice correction, results of the logistic regression are shown in Table 6.

Table 6: The logistic regression model

Variable codes	***coefficients***	***Wald***	***p of Wald***	$OR_i = e^{\beta_i}$
Constante	7.317	3.156	.049	1506.297
GEND	1.368	3.875	.076	3.927
SMRT	1.296	3.320	.068	3.655
AVRG	-1.242	3.785	.052	0.289
Global predicted percentage =76.4%				

GEND: Gender of the student = 0 for female and 1 for male. SMRT: Have you a smartphone or similar with Internet connection; 0 = No, 1 = Yes. AVRG: The average gotten in the courses.

As can be seen, the resulting significant model, with the corresponding logit transformation, is as follows:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 \cdot GEND_i + \beta_2 \cdot SMRT_i + \beta_3 \cdot AVRG_i$$

The model was significant for gender (GEND), having or not a smart phone with internet connection (SMRT) and the average grades of the course (AVRG). Wald test for these variables is significant (*p* less than 0.1) indicate that these coefficients are statistically different from zero and justify a significant contribution to the model. Before the interpretation of results it is important to keep in mind the interpretation of the Odds Ratio coefficient (OR). We should distinguish between an OR greater than one and less than unity. In the first case, an OR> 1 implies that an increase in the explanatory variable leads to an increase in the probability of Y = 1 (presence of technical difficulty in using voice correction) and OR < 1 explains the opposite behaviour, i.e. the greater the value of the independent variable, the lower is the probability of occurrence of the dependent variable Y = 1.

Results show an OR = 3.927 for the gender variable (GEND) showing that the probability that male students face technical difficulties increase in front of females by 3.927 times. In this same line, student with smart phone and internet connection (SMRT) show that are more likely to face problems in using the voice correction than the other students by 3.655 times. This result seems to be unexpected as we assume that more “technological” students are able to find less technical difficulties. However, this could be explained by the fact that these student are used to use the smart phones as a normal way to be connected to internet, to hear music, to chat and to check e mails rather than the traditional use of computers. Finally, for the AVRG variable with an OR =0.289 <1 we can state that for a 1 point increase in the results of the students, the probability that the student face technical problem in using the voice correction decreases 0.289 times. This confirms that more successful students are prone to face less technical problems.

5 CONCLUSIONS

This paper focuses on assessing and comparing student’s preferences, using the AHP, for different alternative of correction documents. On the basis of a nine-point scale pair wise comparison, we obtained the relative importance (weights) of the analysed alternatives. Moreover, we use the logit regression model to analyse factors affecting technical difficulty in using the voice correction. Data was collected from 57 students of agro-food market subject in their second year of the agricultural engineering grade during April 2011.

Results Show a high acceptance of the voice correction method. It seems to be an efficient way of work taking into consideration the quantity and quality of the information transmitted to students in few minutes in comparison to writing or typing corrections. However, improvements are needed of such procedure in order to allow the edition and the time control of the generated audio file. This is because the audio file should be heard entirely even if you need to hear only the last part of the voice comment. It is worth mentioning that it is essential that the university computers for students to be compatible with playing voice with the presence of earphone. The voice correction tools support the need of such investment with the PC rooms in the ESAB (Agricultural School of Barcelona) school where the study have be done.

REFERENCES

[1] Atkins, D. (2005) University Futures and New Technologies Possibilities and Issues, Discussion Paper, OECD/CERI Experts Meetings on “University futures and new technologies”.

[2] Raschke, C.A., The digital revolution and the coming of the postmodern university. 2003, London; New York: RoutledgeFalmer. x, 129.

[3] Saaty, T. (1977) A scaling method for priorities in hierarchical structures. Journal of Mathematical Psychology, 15(6), 234-281.

[4] Saaty, T. (1980) The analytic hierarchy process. New York: McGraw-hill.

[5] Saaty, T. (2003) Decision-making with the AHP: Why is the principal eigenvector necessary?. European Journal of Operational Research, 145(1), 85-91.

[6] Laininen, P. and Hämäläinen, R. (2003) Analysing AHP-matrices by regression. European Journal of Operational Research, 148, 514-524.

[7] Bryson, N. (1995) A goal programming method for generating priority vectors. Journal of the Operational Research Society, 46, 641-648.

[8] Aguarón, J. and Moreno-Jiménez, J.M. (2000) Stability intervals in the analytic hierarchy process. European Journal of Operational Research, 125, 114–133

[9] Kallas, Z., Gómez-Limón, J.A. and Barreiro, J. (2007). Decomposing the value of agricultural multifunctionality: Combining contingent valuation and the analytical hierarchy process. Journal of Agricultural Economics, 58(2), 218 – 241.

[10] Easley, R., Valacich, J., and Venkataramanan, M. (2000) Capturing group preferences in a multicriteria decision. European Journal of Operational Research, 125, 73-83.

[11] Forman, E. and Peniwati, K. (1998) Aggregating individual judgments and priorities with the Analytic Hierarchy Process. European Journal of Operational Research, 108, 165-169.

[12] Hosmer, D. and Lemershow, s. (1992) applied logistic regression. John wiley, nueva york.