Brand image and evaluation of internet companies

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Abstract
The present work develops a method for evaluating the importance that brand image has when assessing the value of an Internet Company. The fuzzy methodology used will allow us to establish the competitive advantages of a Company due to its brand image.

Key words: brand image, fuzzy logic, evaluation of internet company.

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1. Introduction
Growing globalisation and the emphasis that companies put on growth to increase their value lead us to ponder on the significance of brands. In today’s competitive market, a company’s brand may be its most stable and steady asset (Aaker and Álvarez del Blanco 1994; pp. 62-76.).

Brands have an unquestionable economic value and are increasingly the subject of negotiation, with controversy frequently arising as to how their worth should be calculated and incorporated in a company’s accounting systems. In recent years many American, Australian and British companies have chosen to include brands as intangible assets in their balance sheets. The objective of any such move is to strengthen a company’s financial position, especially in the face of possible take-overs or mergers between large companies, or simply when a particular brand is being bought or sold for the best price.

Taking into account the importance of brand evaluation, we show how fuzzy logic techniques can be used to help make realistic estimates of an Internet company’s total worth.

2. Problems associated with evaluating brand image
Because to their intangible nature, brand evaluation is a very subjective exercise, for which reason several evaluation methods have been proposed by the OECD1 (Organisation for Economic Co-operation and Development) normative, these are outlined below:

1. Historical cost. This relates the value of the brand to previous costs associated with it. The problem is that this model may not reflect the present value because it does not take into consideration the quality of the brand obtained but merely the money spent on it. Brands that have not enjoyed success and which offer little hope for the future tend to be overvalued. From an accounting point of view, the historical cost may be taken as the total amount that it has cost to create and maintain the brand. However, this would not be
reflecting the whole picture since what is important is not the amount that has been invested, but the result of that investment. Similarly, to consider the cost of replacing a brand is too theoretical an exercise since it is not clear what is to be replaced: knowhow, sales, distribution network, brand loyalty, perceived quality? There is no clear answer to these questions, and so they are not even considered in these methods.

2. *Present day costs or replacement.* The value of the asset is equivalent to the total cost necessary to construct a new brand with the same value in a given time. This would entail calculating the present value of the investment-related cash flow, using a suitable discount rate. Although this method may throw some light on the present day value, it can make no predictions about the future benefits that may be achieved.

3. *Evaluation based on market position.* Based on data concerning market participation, recognition and position in image and preference polls, a theoretical reply may be obtained through assessing the consolidation of a given brand in the market. However, this type of information provides little help when attempting to evaluate a brand's financial worth. One way used in this method is to ask clients how much they would be willing to pay for certain attributes or characteristics of a product or service, one such characteristic being the brand name (Del Río, A, 1996, pp. 719-730) (Erloz, M. 1995, pp. 348-352).

4. *Projected future returns.* This is important to calculate the future income or cash flow generated by a brand because, for the company that possesses the brand, this calculation represents its true worth. This has been the most widely used method and usually involves extrapolating income at present-day prices (Gómez Arias, T. 1995, pp. 123-132). The main drawback with the method is that possible changes in the market environment are not taken into account when future cash flow is projected. It may be that cash flow does
not depend entirely on the brand but on the administrative and marketing skills of the owners or on the distribution system designed for the brand.

5. Economic criteria. Using the cash flow projected and the contribution of the brand to this, four methods may be used to calculate additional benefits generated by the brand: utility cost, return on capital, “premium benefit” (the return on assets of a company that has intangible assets is greater than that for a company without such assets) and “premium price” (a branded product sells at a higher price than one without a brand). But how can these be calculated? One possibility might be to work according to the long-term plan drawn up for the brand, simply discounting the cascade of projected benefits. The brand’s strength and impact on the competitive environment should be taken into consideration here. Another way might be to estimate the present income and apply a multiplying factor. If the income is not representative because of the ups and downs associated with economic cycles, the mean value of previous years could be used. The multiplication factor represents a way of estimating and fixing the value of future income. To determine the present day value of the multiplier, the competitive advantage of the brand would have to be estimated.

In recent years, especially following the publication of the book “Managing Brand Equity: Capitalizing on the Value of a Brand Name” by David Aaker⁴, there has been a plethora of research papers proposing methods for determining the value of brands (Fernández, P., 2002; pp. 213-340). In all the methods proposed to date, the central problem is always an attempt to explain how a brand creates value for a company and how to measure it correctly. In most of the proposals, attempts are made not to be more subjective than is strictly necessary. However, the choice of any evaluation method normally implies a restricted view of reality, which obliges the researcher to consider a restricted number of elements from the
outset (enabling a precise instrument to be constructed) or to represent reality, with all the imprecision that the term implies, and to operate with “fuzzy” data (knowing that the results will inevitably be imprecise). The decision is reduced choosing between a precise model that doesn’t reflect reality and a vague model that is closer to reality.

3. Evaluating brand value of an internet company

The exact value of a brand varies from sector to sector, and may even vary within a given sector. According to an interesting report on companies in several developed economies, a brand represents about 10% of the total value of an industrial company, about 40% in the financial services sector and the car industry, and 70 to 90% in the food industry and luxury goods sector. In absolute terms, brand value, excluding the value of intellectual property rights or of other intangible assets, may be enormous, especially in a virtual company, for which the search for profitability and the need for effective communication are especially important.

Great effort has been put into creating and communicating lasting brand images over the years. However, this routine has been interrupted by the need to create new brands very quickly, Ya.com, Terra and Netjuice being only a few of the many examples of this change in brand generation.

The need to become well known to Internet users led to enormous promotional effort being spent in 1999 and 2000, during which time conventional publicity campaigns in the traditional media, “below the line” campaigns in cyber-cafes, concerts, companies and universities, and direct on-line and off-line marketing campaigns, stands in trade fairs, etc., were common practice. Many of these promotional activities sought potential investors but many were aimed at the general public to announce the arrival of new names full of promise and potential. In the midst of this activity, the Spanish Technological Shares Index, similar to Nasdaq in the USA, was established, accelerating the whole process. Spanish and international companies, conscious of the medium and long-term importance of the Internet in many areas of society, redoubled
their efforts to reinforce these brands to attract potential partners and investors.

The Internet sector is not all that different from other sectors of the economy. The main difference between clients of an Internet company and those of a conventional one is perhaps that they may feel greater uncertainty and insecurity in carrying out any transactions with an Internet company, although they also appreciate the greater speed with which they can change from one offer to another, compare prices, systems of payment, etc. Uncertainty is linked with the feeling of insecurity and both need to be taken into consideration by Internet companies and, where possible, minimised by brand loyalty schemes which emphasise security protocols, certification schemes that guarantee that the Web is safe, the use of digital signatures that encrypt or encode the information provided by users, etc.

Users find the Internet serious or amusing, informative or educational and, even though they may not buy anything, they may consult the official pages of a many companies to learn of new products, broaden their knowledge of a product or to establish some form of contact. They normally prefer well known companies for commercial transactions because of the sense of security they feel when dealing with a known name, and so they visit such websites frequently. The result is that, although they may not make any great effort to promote customer loyalty, some pages attract a large number of visits. For those companies that have a known brand, the income generated per banner is much higher than for a company that has no brand. So it is with portals. Yahoo, for example, has learnt the advantages of scale, creating externalities by offering a whole series of personalised products and a strong brand image. Excite, on the other hand, has not created such differentiation and has closed down in certain European and Asian markets to concentrate on certain niches, which they hope will be more profitable. Similarly, e-Bay has become the leader in Internet auctions, creating communities of collectors and, through this, has reached the critical mass necessary to launch auctions of all types. At the same time, they have created a strong brand image, attracting even
more buyers and sellers and is a clear case of a company that has known how to create and take advantage of the network effect of the Internet.

In choosing a product or service offered by an Internet company, a series of factors comes into play: these may be of rational dimensions (tangible and easily measurable factors, such as money or product) or emotional (intangible) factors. Emotion plays an important role in the perception of value and in long term loyalty for most consumers, and, although the decision to buy is based on both dimensions, those influenced by emotion tend to be deeper and longer held. In the case of an Internet company, let’s not forget, confidence does not arise spontaneously but is something that grows with time. Confidence needs many positive experiences, many positive feelings and this part of business life should not be forgotten when analysing what a client really appreciates. However, it must not be forgotten that deep satisfaction with a product or service is not a guarantee of satisfaction and does not force a client to any long-term commercial commitment.

Robinette, Brand y Lenz (2001; pp. 58), define emotional marketing as “the search in every company for a sustainable connection that makes clients feel they are so valued and so well cared for that they will go out of their way to be loyal”. Emotional marketing is thus converted into a bridge between satisfaction and loyalty, conferring a strategic value to emotion, recognising its importance in creating and developing a brand image and in the way consumers’ experiences are used. Research into the emotional component of value is at a beginning and proposals and theories will surely not be wanting.

4. The perception of brand image. Its treatment by fuzzy logic

Systems built on fuzzy logic are especially suited to treating processes that are governed by intuitive rules that cannot be expressed mathematically. The great advantage of the method is that it permits the possibility of expressing operations and controlling the rules by words of every day use. Fuzzy logic does away with high maths and goes to the heart of the mat-
ter, enabling an intuitive approach to solving a problem by formulating rules. In this context, it is easy to see how the evaluation of brand image for the subsequent evaluation of the brand-owning company is a good candidate for using techniques of control by fuzzy logic due to their complexity and non-linear behaviour.

In the study of the rational behaviour of consumers, many theoretical models of decision making are based on ordinary binary relations, in which only two modes of preference are allowed (preference or non-preference), and, in the case of brand analysis, whether the brand is considered of primary or secondary importance when deciding to make a purchase. Yet, if one takes into consideration the vagueness, uncertainty or intensity with which human preferences are manifested, it becomes clear that an approach based on diffuse or fuzzy binary relations is more appropriate because these permit preferences to be graded (García Lapresta, J.L.; Lazzari, L.; Martínez Panero, M. 2001, pp. 76-84).

In this way, when an individual expresses a preference about a finite group of alternatives by means of a diffuse or fuzzy binary relation, the intensity or degree of preference of one alternative over another is indicated by a number [0,1]. However, there are many occasions when individuals feel themselves incapable of expressing their preferences by means of a numerical value, either through the vagueness or uncertainty of their preferences, or because they are referring to aspects that are difficult to quantify (Gil Aluja, J. 1999, pp. 20-24). In such cases a qualitative evaluation becomes a better alternative, using linguistic terms or labels and expressed by means of linguistic relations of preference (Nakamura, K. 1986, pp. 147-162). By this means, individuals are presented with a group of linguistic terms according to which they declare their preferences.

The present study takes as its starting point the consideration of linguistic preferences to represent the intensity and importance that brand image has in the decision to buy from an Internet company. Then, in a second phase, a comparison will be made between products as a function of the importance of brand image for each. Finally, a practical application
of the proposed methodology is illustrated to help understand the theoretical background. A graphic description of how the study is developed follows:

**Figure 1. Phases of the study**

Let us consider that an individual expresses his/her preferences (expressed by means of a linguistic relation $P^L$) to buy from a finite group of alternatives $X = \{x_1,x_2,x_3,...,x_n\}$ of products (of similar characteristics but different brands), all of which are offered by Internet companies. Note that a linguistic expression of preference is a diffuse binary relation evaluated according to a group of linguistic terms or labels $S$ so that:
\[ \mu_{pl} : X \times X \rightarrow S \]

The label \( \mu_{pl}(x_i,x_j) = r_{ij} \in S \) will represent the intensity with which the consumer feels influenced by the brand in choosing \( x_i \) in preference to \( x_j \) at the time of purchase.

The set of labels \( S = \{s_0, s_1, s_2, ... s_T\} \) is finite and totally ranked so that \( s_i \geq s_j \) if \( i \geq j \). The central label \( s_{T/2} \) represents indifference on the consumer’s part since he/she does not notice the brand, while the remaining labels are equally distributed either side of it (Nurmi, H. 1981, pp. 249-259). Furthermore, the operator \( \text{Neg} \) assigned to each label your symmetrical: \( \text{Neg}(s_i) = s_j \) so that \( j = T-i \)

The set of linguistic terms considered depends on the problem domain. For example, in our context, we consider the following set of labels when comparing different pairs of alternatives:

- \( S_0 \): if you totally prefer the second alternative to the first because of the brand.
- \( S_1 \): if you very much prefer the second alternative to the first because of the brand.
- \( S_2 \): if you quite prefer the second alternative to the first because of the brand.
- \( S_3 \): if you slightly prefer the second alternative to the first because of the brand.
- \( S_4 \): if you feel indifferent about the relative merits of the two brands (the brand does not influence the purchase).
- \( S_5 \): if you slightly prefer the first alternative to the second because of the brand.
- \( S_6 \): if you quite prefer the first alternative to the second because of the brand.
- \( S_7 \): if you very much prefer the first alternative to the second because of the brand.
- \( S_8 \): if you totally prefer the first alternative to the second because of the brand.
To statistically treat the information provided by the labels, each one is assigned a value, to define which there are two possibilities (Herrera, E., Herrera Viedma, E. 2000; pp. 626-632):

1. Represent each label by a given diffuse set in the range (0,1) and described by memberships functions.
2. Assign a value in the range (0,1) to each label, following the ranking of the linguistic terms. This value can be interpreted as a quantitative degree of preference representing the linguistic preference (Meneses Poncio, L.C. 2003, pp. 389-402).

After these remarks concerning the theoretical basis of the theory of diffuse linguistic preference, we now describe the empirical methodology used in the study to assess the degree of importance given to the brand when making a purchase from an Internet company.

The study is based on a survey of a group of actual or potential consumers (who had shown interest at some time in purchasing the selected products) as regards the preferences they show for a series of articles of different brands (four) but of similar characteristics offered by different Internet companies. The consumers must demonstrate their preference between the four products in terms of the brand, comparing all the alternatives arranged in pairs, but first only taking into consideration their personal views of each product with no outside reference and then also taking into consideration the price (in euros) that they would be willing to pay for the same product with a well known brand. The subjects had to compare each pair of alternatives by means of four levels of preference (“totally”, “very much”, “quite” and “slightly” prefer) or, in the absence of any preference, choose “indifferent”. The questionnaire had the following form:

<table>
<thead>
<tr>
<th>Product A</th>
<th>Product B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally</td>
<td>Very much</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The next step in the study was to rank the products according to the importance of their characteristics and preferences shown by the subjects. In this way, it is possible to appreciate the relative importance of the product compared with a rival product by establishing a fuzzy relation that points to the connections between the products considered two at a time by reference to a set of characteristics (Puente García, J. 2000, pp. 68-72).

We start with the finite referential sets representative of the products to be ranked and of the characteristics considered as determinant in the decision to buy (brand, technical characteristics, novelty, security, etc.). Following the general nomenclature, these will be, respectively: referential products: $X = \{x_1, x_2, \ldots, x_n\}$, and referential characteristics considered: $C = \{C_1, C_2, \ldots, C_n\}$

For each characteristic $C_j$, $j = 1, 2, \ldots, n$, a pairwise comparison of the products is made, $C_i \succ C_k$; $i, k = 1, 2, \ldots, n$, by a quotient that determines the number of times that one product is favoured to another. Hence

$$
\mu_{i,k} = \frac{f_i}{f_k} \quad \text{for } i, k = 1, 2, 3, \ldots, n.
$$

represents the number of times that $C_i$ is preferable to $C_k$. The joining of all the $\mu_{i,k}$ will give a matrix for each characteristic $C_j$, which, by construction, will be reciprocal. Remember that a matrix is reciprocal if $\mu_{i,i} = 1$ and $\mu_{i,k} = \frac{1}{\mu_{k,i}}$ for, $\mu_{i,k} \in R_{++}$, $i, k = 1, 2, \ldots, n$.

When: $\forall i, k \in \{1, 2, \ldots, n\}$ and, $\frac{f_i}{f_k} = \frac{f_{i,j}}{f_{k,j}}$, are fulfilled $\mu_{i,k} \cdot \mu_{i,j} = \mu_{j,k}$ that is the matrix is said to be “coherent” or “consistent”.

When a matrix in $R_{++}$ is reciprocal and coherent, it possesses some elemental properties that will be useful for the objectives of this work:

1. $\sum_{k=1}^{n} \mu_{i,k} \cdot f_k = \sum_{k=1}^{n} \frac{f_i}{f_k} \cdot f_k = n \cdot f_i$

2. All the rows (and columns) are proportional to the first row (or column) and so every row (and column) will be equal to another row (or column) multiplied by a coefficient. (Gil Aluja, 1999; pp. 321-337).
It is possible to obtain a reciprocal, but not necessarily coherent, matrix for every characteristic \( C_j \), \( j = 1,2,3,..., n \). Any positive squared matrix will have its own real value, whose modulus will be higher than all others - real or complex. This dominant real or positive value, which we shall call is unique according to Perron-Frobenius. If \( n \) is the order in the matrix, then \( \lambda_1 \) \( n \) The vector corresponding to the dominant eigen value \( \lambda_1 \), by means of which the relative preference for a product as a function of its respective characteristics is revealed, will be formed by positive terms and, after normalisation, is unique. Thus, a positive and reciprocal squared matrix of order \( n \) will have a dominant eigen value of \( \lambda_1 \). When \( \lambda_1 \) is very close to \( n \), the matrix may be said to be quasi-coherent and so will be suitable for the study in hand. The coherence index is normally established as: 

\[
I_s = \frac{\lambda_1 - n}{n}.
\]

In this way, based on the referential objects to be ranked \( X \), and of the characteristics \( C \), a reciprocal matrix for each characteristic with its own value \( \lambda_1^{(i)} \), and coherence index, will be obtained. If this coherence index is sufficiently reduced the corresponding vector will be accepted as valid (Zadeh, L.A. 1971, pp. 159-176).

In summary, the matrix will have its own dominant eigen value \( \lambda_1^{(\circ)} \) and a corresponding vector \( [V^{(\circ)}] \) as representative of the weight and importance of each characteristic, and of how these affect the decision. This vector may play a weighting role in our scheme, so that, in accordance with Gil Aluja (cited above), it will be necessary to normalise with a sum equal to unity.

Once the matrix \( [V] \) and normalised vector \( [N^{(\circ)}] \) have been obtained the two terms can be multiplied to provide the new vector \( [V]^{\ast} [N^{(\circ)}] \) whose values will permit the products to be ranked, taking into account the relative importance assigned to each characteristic. To obtain the dominant eigen value and the corresponding vector, the method proposed by Gil Aluja (cited above) is followed:

Let us suppose a squared reciprocal matrix \( [M] \):
\[ [M] = \begin{pmatrix}
1 & \mu_{12} & \ldots & \mu_{1m} \\
\mu_{21} & 1 & \ldots & \mu_{2m} \\
\vdots & \vdots & \ddots & \vdots \\
\mu_{m1} & \ldots & \ldots & 1
\end{pmatrix} \]

The process is started by multiplying the matrix \([M]\) by the vector unity \([1]\), which gives the vector \([W_1]\).

\[
\begin{pmatrix}
1 & \mu_{12} & \ldots & \mu_{1m} \\
\mu_{21} & 1 & \ldots & \mu_{2m} \\
\vdots & \vdots & \ddots & \vdots \\
\mu_{m1} & \ldots & \ldots & 1
\end{pmatrix} \begin{pmatrix}
1 \\
1 \\
\vdots \\
1
\end{pmatrix} = \begin{pmatrix}
w_{1}^{(1)} \\
w_{2}^{(1)} \\
\vdots \\
w_{m}^{(1)}
\end{pmatrix} = [W_1]
\]

Then, each of the values of the vector \([W_1]\) is divided by the greatest of them \(w_{1}^{(1)} \lor w_{2}^{(1)} \lor \ldots \lor w_{m}^{(1)}\). This quotient is termed \(V_1^{(1)}\). In this way, a vector normalised according to the logic the fuzzy sub-sets is obtained. These new values are termed:

\[
V_1^{(1)} = \frac{w_{1}^{(1)}}{w_{1}^{(1)} \lor w_{2}^{(1)} \lor \ldots \lor w_{m}^{(1)}} ; \quad V_2^{(1)} = \frac{w_{2}^{(1)}}{w_{1}^{(1)} \lor w_{2}^{(1)} \lor \ldots \lor w_{m}^{(1)}} ; \quad \ldots
\]

Where at least one \(V_i^{(1)} i = 1, 2, 3, \ldots m\) is equal to unity. Then, we multiply \([M]\) \([V_1]\) to obtain \([W_2]\). After normalising again \([W_2]\), we repeat the above-described process to find a value so that:

\[
w_{1}^{(r)} \lor w_{2}^{(r)} \lor \ldots \lor w_{m}^{(r)} = w_{1}^{(s)} \lor w_{2}^{(s)} \lor \ldots \lor w_{m}^{(s)}
\]

where \(r = s-1\). When this occurs it is said that \(w_{1}^{(s)} \lor w_{2}^{(s)} \lor \ldots \lor w_{m}^{(s)}\) is the dominant eigen value \(\lambda_s\). If the coefficient of coherence \(I_c\) is reduced to an acceptable degree the matrix is almost coherent and valid for ranking the elements considered.
To illustrate the methodology and to make it easier to understand, we present a practical example.

Let $X = \{a,b,c,d\}$ be the set of products to be ranked according to certain characteristics representative of the importance of the brand in the decision to buy, which are resumed in another set $Y$. Let these sets be: $X = \{a,b,c,d\}$; $Y = \{A,B,C,D,E\}$. The linguistic labels associated with the characteristics $A,B,C,D,E$ that we have considered as the following: $A$, confidence in the brand; $B$, customer satisfaction with the brand; $C$, sense of security conferred by the brand; $D$, prestige; $E$, quality of service associated with the brand image.

For each of these characteristics $A,B,C,D,E$, the corresponding matrices are established, representative of the relative appreciation of each product compared with the others.

\[
A = \begin{bmatrix}
1 & 3 & 1.67 & 6 \\
0.34 & 1 & 0.5 & 3 \\
0.6 & 2 & 1 & 4 \\
0.167 & 0.34 & 0.2 & 1 \\
\end{bmatrix}, \quad B = \begin{bmatrix}
1 & 2.5 & 7.3 & 8 \\
5 & 1 & 4 & 4 \\
6 & 0.33 & 1 & 2 \\
3 & 0.9 & 0.23 & 1 \\
\end{bmatrix},
\]

\[
C = \begin{bmatrix}
1 & 0.8 & 3 & 0.45 \\
0.32 & 1 & 0.5 & 0.95 \\
3 & 4 & 1 & 2 \\
1 & 0.8 & 3 & 1 \\
\end{bmatrix}, \quad D = \begin{bmatrix}
1 & 2 & 4 & 0.6 \\
0.2 & 1 & 0.23 & 0.25 \\
3 & 0.32 & 1 & 3 \\
0.54 & 0.52 & 0.53 & 1 \\
\end{bmatrix},
\]
E:
\[
\begin{array}{cccc}
  & a & b & c & d \\
  a & 1 & 3 & 0.32 & 1 \\
b & 0.5 & 1 & 2 & 0.32 \\
c & 0.23 & 0.5 & 1 & 3 \\
d & 1 & 0.23 & 0.14 & 1 \\
\end{array}
\]

For the first characteristic A representing confidence in the brand, the matrix of the results indicates that the product a is 3 time more valued than b; 1.67 time more than c and 6 time more than d and so on. The way in which the dominant eigen value and corresponding vector for the characteristic A is obtained is explained below.

The process is started by multiplying the matrix [M] by the vector unity:

\[
\begin{array}{cccc}
  & a & b & c & d \\
  a & 1 & 3 & 1.67 & 6 \\
b & 0.34 & 1 & 0.5 & 3 \\
c & 0.6 & 2 & 1 & 4 \\
d & 0.167 & 0.34 & 0.2 & 1 \\
\end{array} \times \begin{array}{c}
  1 \\
  1 \\
  1 \\
  1 \\
\end{array} = \begin{array}{c}
  11.67 \\
  4.84 \\
  7.6 \\
  1.707 \\
\end{array}
\]

The dominant eigen value 1.67; and vector are:

\[
\begin{array}{c}
  1 \\
  0.41473865 \\
  0.6512425 \\
  0.14627249 \\
\end{array}
\]

Each of the values of the vector [W] is divided by the greatest, giving a normalised vector according to the logic the fuzzy sub-sets. The matrix is multiplied by this vector.
The dominant eigen value 4.20942588; and the corresponding vector are shown below:

\[
\begin{pmatrix}
1 & a \\
0.36089895 & b \\
0.63329533 & c \\
0.13886267 & d
end{pmatrix}
\]

The process is repeated until a dominant eigen value \( \lambda_1^{(1)} = 4.0075236 \) is reached. The index of coherence \( I_c \) will be:

\[
I_c = \frac{\lambda_1 - n}{n} = \frac{4.0075236 - 4}{4} = 0.00188
\]

Given that the index of coherence is within the threshold value demanded, vector \([V^{(1)}]\) is considered representative of the weight and importance of each characteristic for making a decision. This vector may play a weighting role in our scheme, so that it is always convenient to normalise it making the sum of the squares equal to unity\(\bar{N}^0\).

The corresponding vector \([V^{(2)}]\) for characteristic A is:
and normalising with 1:

\[
\begin{array}{|c|}
\hline
0.4688545 & a \\
0.1693367 & b \\
0.2962709 & c \\
0.0655377 & d \\
\hline
\end{array}
\]

The same process is carried out with the rest of the characteristics, B, C, D and E, the resulting vector corresponding to the five characteristics being:

\[
\begin{array}{|c|}
\hline
A & 4.0075236 \\
B & 11.5880548 \\
C & 5.9471805 \\
D & 5.10773071 \\
E & 5.50725104 \\
\hline
\end{array}
\]

With the normalised matrixes obtained for the five characteristics considered, the following matrix is established [V]:

\[
\begin{array}{|cccccc|}
\hline
 & A & B & C & D & E \\
\hline
a & 0.4688545 & 0.3270928 & 0.2644081 & 0.4319042 & 0.3243456 \\
b & 0.1693367 & 0.3412796 & 0.1071151 & 0.0504813 & 0.2081081 \\
c & 0.2962709 & 0.2100847 & 0.3636377 & 0.4027342 & 0.3734255 \\
d & 0.0655377 & 0.1215427 & 0.2646235 & 0.1148801 & 0.0941206 \\
\hline
\end{array}
\]
Multiplying matrix \([V]\) by vector \([N^0]\) gives:

\[
\begin{array}{c|c}
11.2341005 & a \\
6.6743688 & b \\
9.89801049 & c \\
4.34997345 & d \\
\end{array}
\]

This vector allows the products to be ranked based on the importance of the brand image when making a decision to buy, the result being:

\[ a > c > b > d \]

In this way we can appreciate the relative importance of the product compared with the other products by establishing a fuzzy relationship that shows the connections between the products according to given referential characteristics.

5. Conclusions
When studying the rational behaviour of consumers, most models of decision-making theory are based on ordinary binary relations, where only two modalities of preference are possible (I prefer or I do not prefer) and, in the case of brand image, whether it is considered as of primary or secondary importance. However, if the vagueness, uncertainty or intensity of the way in which human preference is taken into account, it is more appropriate that an approach based on diffuse or fuzzy binary relations is more appropriate because these make it possible to grade preferences. This has been the central idea behind this study.

The methodology developed in the present study is based on the consideration of linguistic labels representing the degree of importance that the brand image has in the decision to buy from an Internet company. The results generated from applying this methodology provide a realistic idea of the competitiveness of a company compared with other Internet com-
panies dedicated to similar activities. In this respect, we consider it an advance over classical methods of evaluating the worth of companies and one which will be increasingly used in the future, when the problem of evaluating looks at intangibles and subjectivity, when historical data are not available or when degrees of preference need to be taken into account.

At present we are engaged in developing a real application of the diffuse model for estimating the importance of intangibles, using a sample of 512 observations for the electronic goods business in the province of Murcia, Spain.

6. Bibliography


