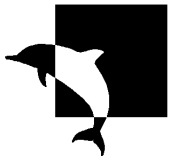

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An Approach to the Measurement of Intangible Assets in Public Sector using Scaling Techniques

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AN APPROACH TO THE MEASUREMENT OF INTANGIBLE ASSETS IN PUBLIC SECTOR USING SCALING TECHNIQUES

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THE MEASUREMENT OF INTANGIBLE ASSETS IN THE PUBLIC SECTOR USING SCALING TECHNIQUES

ABSTRACT

This paper discusses the identification and measurement of intangible assets in the public sector. A discussion of Intellectual Capital theory identifies and classifies a number of intangible assets of relevance to the Public Sector. Multidimensional Scaling and related multivariate techniques are proposed for their detection and quantification. The methodology is illustrated with a case study: the provision of council services through the Internet by Spanish municipalities. The technique identifies three intangible assets related to external structural capital: service, image and transparency. Five strategic groups reveal the different objectives, strategic use of Internet, and actions taken by the various Spanish councils.

KEY WORDS

Public sector, intangible assets, non-financial indicators, service quality, Intellectual Capital, multidimensional scaling, strategic groups, Internet.

THE MEASUREMENT OF INTANGIBLE ASSETS IN THE PUBLIC SECTOR USING SCALING TECHNIQUES

1. INTRODUCTION

Every day, Public Sector managers have to take decisions that involve intangible assets. For example, it is clear that organising a world-wide event, such as some international sporting games, demands substantial investment, but it is not clear what is the profitability of such an investment, since benefits such as image are very difficult to quantify. Another example could be the introduction of Information Technology in public services; a city council may reduce queues in the provision of a service by allowing individuals to apply for it through the Internet. This would result in an increase in citizen satisfaction. How could it be measured?

Any executive in the public or private sector knows the importance of intangible assets, even if these do not get reflected in the statements of accounts or internal reports. Interest in the identification, measurement, and management of intangible assets has grown in recent years, particularly as part of what has become known as “Intellectual Capital”. Public bodies know the importance of identifying intangible assets, as they acknowledge their relevance in order to take better decisions and aim to prove to the public the quality of their management processes. It is not unusual to supplement traditional financial reports with indicators devoted to intangible asset management. Pioneering work on Intellectual Capital management was done by Brooking (1996), Sveiby (1997), Edvinsson and Malone (1997), and Stewart (1998).

Many empirical studies on intangible assets in the private sector have now been published. Aboody and Lev (1998), Barth and Clinch (1998), Lev (1999), Kristen and Gregory (1999), and Deng et al (1999) assess their impact on share prices. Cañibano, García-Ayuso and Sánchez (2000) give a literature review on the importance of intangibles on firm valuation and management. Stolowy and Jeny (1999) study the legislation applied by various countries and international bodies for the accounting of intangible assets.

In contrast with the interest that the private sector has shown in the identification and valuation of intangible assets, which includes reporting “Intellectual Capital Balances” as an annex to their annual accounts, public sector bodies have made less of an effort in this

direction. This is to be regretted, since intangibility is even more present in the public sector than in private enterprises. There are several reasons for this to be the case. First, because public administrations, unlike the private sector whose main objectives are profitability and firm value, tend to have multiple objectives of a non-financial nature. Second, because even if both the public and the private sector use the same production inputs- human resources, knowledge, money, raw materials, and plant-, the public sector makes more intensive use of the first two, and these are intangible. Finally, because the final product of public administration is a service, and this is essentially intangible.

The usual approach to the assessment of the importance of intangible assets is to use measurable variables that are related to the intangible asset. For example, workforce stability, an intangible asset, is sometimes measured through the median age of the staff. But an intangible asset is associated with more than one measurable variable. Take the same example of workforce stability; this is also associated with qualified staff turnover, qualified staff years of service, or a satisfaction index obtained from a survey. However, the identification of variables that are related to the intangible asset should only be the first step in the measurement of such an asset. The various measurable variables could enter with different weights in the construction of an index associated with the intangible asset. This is a standard issue in Statistics, which was faced by researchers such as Galton, Spearman, and Thurstone when they were attempting to measure an intangible, human intelligence. This work resulted in the development of Factor Analysis, which is the traditional approach of relating non-observable factors to measurable variables. Factors can be measured on the basis of linear combinations of observable variables, and rankings can be produced on the basis of factor scores. Scaling models provide a technical apparatus closely related to Factor Analysis; Chatfield and Collins (1980). Scaling models have the advantage of visualising the relationships between the factors and the variables, do not assume linearity in the relationship between variables and factors, are very flexible with respect to data definition, and can also be used to produce rankings. A case study, the provision of web services by city councils, is used to illustrate how scaling models can be of use in the identification and measure of intangible assets in the public sector.

Next section in this paper is concerned with the special problems created by the public sector when trying to apply Intellectual Capital theory. The main relevant intangible assets are identified and grouped in various categories. This is followed by the empirical study,

based on 72 Spanish city councils and the services they offer through the Internet. The last section contains the conclusions of the study.

2. INTANGIBLE ASSETS IN THE PUBLIC SECTOR

This section contains two parts: the distinctive features of intangible assets in the Public Sector, and a discussion on Intellectual Capital models in the Public Sector.

2.1 Distinctive features of intangible assets in the Public Sector

To translate the theory of intellectual capital from the Private to the Public Sector, the differences between these two sectors have to be taken into account: the Public Sector has intangible objectives; it provides services that are of an intangible nature; many of the resources used by the Public Sector are intangible; and the Private and the Public Sectors use intangible assets in different ways. These will now be discussed.

The Private Sector is concerned with profitability and shareholder's wealth. The Public Sector has intrinsically intangible objectives such as national security, the administration of justice, or raising the general level of culture. These cannot be measured by making reference to stock prices. Financial ratio analysis is of limited use in this situation. This explains the popularity of techniques such as performance indicators or Data Envelopment Analysis; Thanassoulis et al (1987), Ganley and Cubbin (1992), Seiford (1996), and Mancebon and Mar Molinero (2000).

Although the Public Sector sometimes produces tangible assets such as roads, most of its outputs are services, and these are fundamentally intangible. The quality of tangible assets can be assessed by means of standardised quality control procedures, but these procedures are not easy to apply in the case of services, which have to be valued in ad-hoc ways.

The Public Sector uses intangible resources. Traditionally, the resources used in the production process are listed as: raw materials, plant, capital, and human resources. Knowledge is today considered to be a fundamental input to be added to the list. Human resources and knowledge are intangible assets. These play a more important role in the

Public than in the Private sector, since raw materials, plant and capital take do not take such a prominent role in the Public sector as they do in the Private sector.

Intangible assets are used and valued in a different way by the Public and the Private sectors. In the Private Sector intangible assets are an input to the production process whose objective is to increase profitability. Firms are interested in the monetary quantification of intangible assets, and this becomes indispensable in situations such as a take over. A private enterprise would like to know how much a satisfied customer is worth in terms of future sales. A manager in the Public Sector may not be interested in the monetary value of an intangible asset, but has to make a rational use of it. For example, foreign links are an intangible asset for a university but, how can they be valued in the context of the quality of teaching and research within the university? It does not make sense to try to quantify in monetary terms the contribution that the link makes to the quality of teaching, or to the quality of research, but it makes sense to catalogue the links and to assess their impact in the university.

2.2 Intellectual Capital models in the Public Sector

The Balanced Scorecard -Kaplan and Norton (1992)- has been proposed as an Intellectual Capital model, albeit it is better described as a strategic management system which makes some use of intangible asset indicators. Charlotte City (1994) pioneered its use in city council management. It has also been used in hospitals and other public sector institutions; see Johnsen (1999 and 2000). Its implementation was not devoid of difficulties because of its orientation towards profit and long term wealth creation.

Business Navigator is another model frequently quoted in the literature; Edvinsson and Malone (1997). It concentrates on the market value of the firm, which is obtained from the addition of financial and intellectual capital. The intellectual capital is assumed to be made up of human capital and structural capital. Structural capital, in turn, is divided into customer capital and organizational capital. Edvinsson and Stenfelt (1999) applied this model in the Public Sector and introduced the concept of National Intellectual Capital as a source of wealth.

Other Intellectual Capital models of interest were developed by Brooking (1996), Sveiby (1997), and Roos (1996). This last model was applied by a public sector agency in

Australia; see Dragonetti and Roos (1998). A literature survey of intellectual capital models and of instruments for the measure and management of intangible assets is given by Bontis et al (1999).

Existing Intellectual Capital models rely on the difference between the market value of the firm and its book value, and this does not translate easily into the Public Sector. It does not make sense to ask what is the market value of a city council or of a police service. Such accounting concepts as profit from operations, working capital, trade names, or goodwill either have no meaning or mean different things. Any Public Sector management model that includes in its definition indicators of intangible assets ought to reveal their importance in the achievement of the aims and objectives of the institution. The model should highlight how such intangible assets are used to improve the quality of the services offered to the public, it should show their relevance in the achievement of management excellence, and it should reflect the institution's commitment to social and environmental improvement.

Besides having different objectives, there also exist differences between the components of Intellectual Capital between the Private and the Public Sectors. For example, an intangible such as "customer capital"- also known as "external structure"- is measured in the Private Sector by the value of goodwill and the value of trade names. In the Public Sector, one could address the public as "customers" but this cannot have the same meaning as in the Private Sector, given the lack of competition and the fact that there is usually no choice. Typical Intellectual Capital indicators such as percentage of customers lost cannot be computed in the Public Sector. There are no trade names in the Public Sector, although image can be important. Human and organisational capitals have their peculiarities in the Public Sector: Civil Servants have their own culture. The need for transparency in management is central to the Public Sector.

Many of the contributions to the theory of Intellectual Capital, and many of the indicators proposed in the Private Sector are, despite the above-discussed differences, of relevance to the Public Sector. In Table 1 an attempt has been made to produce a list of intangible assets of relevance to Public Sector management. These have classified into four groups: internal organisation, external structural capital, human capital, and social and environmental commitment. Each one of these groups will now be discussed in detail.

Table 1 about here

Internal Organisation intangible assets relate to processes, work procedures, and skills that make it possible for the organisation to function and to achieve its objectives. The "ability to innovate" allows the organisation to adapt to changes in the environment. The "Know How" reflects accumulated knowledge, working procedures, and ways of approaching problems. An efficient organigram, which encourages internal information flows, is an important intangible asset that can be called "structural organisation capital". "Corporate culture", the collection of values shared by the institution, can also be considered to be an intangible asset. Goddard (1997), amongst others, has studied the types of organisational culture that exist in Public Administration and has identified four models: bureaucratic, strategic, social, and task-oriented. He has explored the influence of the different types of cultures on the Public Sector. "Links and contacts" are a further external intangible asset. In the Private Sector it is very important to count on strategic alliances with other firms or, in general, good relations with the environment. This is also true of the Public Sector, where links with other institutions, social agents, or the media can be of much value in the attainment of specific objectives. For example, the ability that the institution may have to influence political decision-making may even determine its budget.

Amongst the intangible assets related to External Structural Capital, "service" takes prominence, since public bodies aim at user's satisfaction. Parasuraman, Berry and Zeithaml (1991) proposed SERVQUAL, a methodology that values service quality. They identified five underlying factors: assurance, empathy, responsiveness, reliability and tangibles. The concept of trade name, listed in the financial statements of private companies as an intangible asset, has its parallel in the "image" conveyed by the institution or by the service offered. Image may be an important intangible asset for a public institution, since it may contribute to the attainment of its objectives, or to increase capital flows and development opportunities. The interaction with political decision making greatly benefits from another intangible asset: "transparency". Politicians, have to face the electorate regularly and need to show that there has been no corruption in the management of public money.

In the group labelled Human Capital, we find “aptitudes of civil servants” since human resources, with their skills, knowledge and attitudes are crucial to the achievement of the objectives of the institution; Klase (1996). A well-qualified staff team, made up of active and competent individuals who are able to innovate and even to have a positive influence, is an important intangible asset. Another intangible concept is “permanent training”, since the organisation must ensure that its staff are kept up to date with developments. Finally, “conditions of service” such as working atmosphere, promotion opportunities, incentives, work security, and safety influence staff performance.

Many firms in the private sector consider a Social and Environmental Commitment as no more than an expense, although some are already considering it as an intangible asset that improves their image. It is common for these firms to report on the impact of their actions on the environment and on society in annexes to their annual reports; Roberts (1992). In the case of public institutions this should be a must. In our opinion, the Public Sector should not see this commitment as a mere way of improving an image, but it should be an important objective. The intangible “social commitment” has long been studied in Accounting; Mathews (1993). Human Resource Accounting is now an important aspect of Social Accounting; Likert and Bowers (1968), and Brummet, Flamholtz and Pyle (1968). Finally, the intangible “environmental commitment” reflects the measures taken by public administrations to forward the objective of safeguarding the environment.

Having introduced the general framework for the study of intangible assets in the Public Sector, it becomes necessary to identify and to measure the intangible assets held by each institution. The next section reports the case study of Spanish city councils and the services they offer through the Internet. A set of variables related to such intangible assets will be suggested, and the situation will be modelled by means of scaling techniques.

3 MEASURING INTANGIBLE ASSETS WITH SCALING METHODS

This study concentrates on Spanish city councils, specifically on the services offered through the Internet. Since the Internet is a tool for external relations, the study will reveal aspects of external structure capital and related intangible assets. How can we measure what is, by definition, unmeasurable? It will be sufficient to obtain a ranking of city

councils according the value of such an intangible asset. A methodology based on scaling models will be proposed. A by-product of the methodology will be the identification of various strategies, or patterns of behaviour. This section will be divided into three subsections. The first subsection will discuss the data. The second subsection will concentrate on modelling issues. The last subsection will discuss the results.

3.1 The sample and the data

The sample contains 72 Spanish city councils: the 52 provincial capitals and all other councils with populations of more than 100,000 inhabitants. Data was obtained directly from their web pages. Once the data was collected it was sent to their webmasters, so that city councils had the opportunity to correct any errors. Table 2 lists the city councils in the study, the number of their inhabitants, and their web addresses. City councils are listed in the order of an index of "service". How this index has been calculated will be discussed below.

Table 2 about here

Some city councils give citizens the opportunity to obtain services and information through the Internet, thus avoiding queues and delays. The level of services offered in this way is an intangible asset whose assessment is the main purpose of this study. There is no simple way of measuring the quality of this service, although it is possible to think of related performance indicators. The selection of such indicators is crucial. GASB (1987) recommendations of relevance, comprehensiveness, understandability, timeliness and reliability of performance measures were followed, and resulted in the selection of 36 variables taken from their web pages. The information relates to September 2001.

The complete list of variables and their definitions is given in Table 3. This table also contains the short names used in the study. These variables are of various kinds. Some reveal the services that are accessible through the Internet. Examples are the possibility of checking on the progress of administrative procedures (V8), the possibility of paying local taxes through the web (V10), access to information of various kinds such as cultural events (V5), or directories (V17). Other variables relate to transparency and legal aspects.

For example, variable V26 checks if the annual accounts and public auditor's report are available; information about human resources in the city council is captured by variable V31. Variable V34, which captures information about grants available, reflects social commitment. Other variables measure environmental commitment; for example, V32 takes into account on-line information on pollution levels.

Table 3 about here

The variables are measured on a variety of scales; Stevens (1946). Some variables are measured on a dichotomous 0-1 scale. Others are measured on a polytomous ordinal scale. Other variables were measured on a ratio scale, but were categorised into an ordinal scale. The last column of Table 3 shows the range of values covered by each variable.

Variable V3, which measures the existence or not of an electronic mail address for complains is an example of a dichotomous variable. An example of a polytomous ordinal variable is V5, which measures information on various cultural events such as theatre, cinema, concerts, activities for children, public lectures, etc. V5 takes the value 0 if there is no information about such events; it takes the value 1 if only one category of events is covered; it takes the value 2 if two categories of events are covered; and so on until the value 5 which indicates more than four categories of events. An example of a variable measured on a ratio scale that was translated into an ordinal scale is given by V6, the number of forms that can be filled in by remote access. This variable took the value 0 if no forms could be filled in this way; the value 1 for up to 4 forms; and so on with a maximum of 8 for 54 forms, the maximum number in the data set. Some variables had very little variation within the data set; for example, only a very small number of councils provided the possibility of checking on administrative steps (V8), or on the progress of public work in the city (V28), or informed on projects to popularise the use of Internet amongst the citizens (V30). It will be seen later that this lack of variability caused problems in several statistical analyses.

Any attempt to produce league tables based on single indicators, or on a score obtained by adding several a priori selected variables, may produce perverse effects. To see how this could be the case, take the interesting case of the city of Teruel. There have been a variety of studies on the "quality of life of Spanish cities" that compare the 52 Spanish

provinces. In several of them Teruel is ranked second -El Mundo (1999)-, third -El Periódico de Aragón (2000)-, or number forty -El País (2000)-. Such differences arise from the choice of indicators. During the 20th Century, Teruel had no motorways, no direct train links with the capital of Spain, and the province lost 40% of its population to internal emigration. It is a city without congestion, crime, or pollution; there is not even unemployment, as young people emigrate. All three studies are correct in their own way. Teruel is a leader if we weigh the environment as an indicator of "quality of life", but if we take into account infrastructures, or economic dynamism it appears at the bottom of the list. This would be just anecdotal, were it not for the fact that Teruel fails to receive Objective 1 European Union Structural Funds on account of wealth indicators such as Per Capita Income, which are high due to its population sparcity. We are of the opinion that the problem arises from trying to measure a complex intangible asset, such as "quality of life" with a mere addition of observable indicators. It would be much more appropriate to accept that the concept of quality of life is multidimensional, and that it has to be treated as such. In what follows we will use the techniques of multivariate analysis in order to address the identification and valuation of intangible assets in all their richness.

3.2 Multidimensional Scaling

Amongst all the multivariate statistical models available, this study uses Multidimensional Scaling (MDS). This is because MDS, besides conducting data reduction and analysis, results in statistical maps that visualise the main features of the data. Statistical studies of city council data that result in graphical representations are common, although they tend to be conducted using Principal Components Analysis (PCA); for an example see Thunhurst (1985). PCA and MDS have much in common, and they are equivalent when the data used satisfies some restrictive conditions; Chatfield and Collins (1980). In our particular case, such conditions are not satisfied given the scales on which the data has been measured.

MDS works from a measure of how different two entities, in this case two city councils, are. This is known as a measure of dissimilarity. Measures of dissimilarity can be constructed in many different ways, although the results tend to be quite robust to this choice; Coxon (1982). The table of measures of dissimilarity between pairs of city councils is used as the input to an algorithm first developed by Kruskal (1964). The rationale of the algorithm is

simple: a map is constructed in such a way that if two city councils are not very different, they are placed next to each other in the space; if they are very different, they are placed far apart. This map (configuration) is usually constructed in more than two dimensions. This makes it necessary to work in projections on to pairs of dimensions. It is common to find that the main characteristics of the situation at hand can be observed in one or two such projections. Visual inspection of the resulting figures is always useful, but more formal techniques, such as cluster analysis or multivariate regression, are desirable to avoid subjectivity. Examples of MDS applications in Accounting are: Green and Maheshwary (1969), Moriarity and Barron (1976), Belkaoui and Cousineau (1977), Rockness and Nikolai (1977), Frank (1979), Libby (1979), Belkaoui (1980), Brown (1981), Emery et al (1982), Bailey et al (1983), Mar-Molinero and Ezzamel (1991), Mar-Molinero et al (1996), Mar-Molinero, and Serrano-Cinca (2001), and Serrano-Cinca et al. (2001).

Categorical Principal Components (CATPCA) was used in order to assess the dimensionality of the data set; Van der Kooij and Meulman (1997). City councils were treated as observations and indicators were treated as variables. Eleven eigenvalues were found to have values higher than 1.0. The striking feature of the analysis is that the first eigenvalue accounted for 32.8% of the variability in the data. The second eigenvalue accounted only for 6.4% of the variance, a dramatic drop. The importance of the remaining eigenvectors decreased slowly, the 11^{th} eigenvalue accounting for 3.1% of the variability. It is clear that the first principal component conveys an important story. Following these results, one would expect to produce a map in eleven dimensions. The first dimension being the most salient, and the remaining dimensions adding colour to the picture.

The calculation of measures of dissimilarity between city councils, on the basis of the 36 variables for which data was available, was a delicate business. First, the range of all the variables was standardised to [0,1]. When a variable was defined as dichotomous, the standardisation had no impact. For polytomous ordered variables, standardisation involved a division by the maximum value in the range. The measure of dissimilarity between any two city councils was the Euclidean distance between variables thus standardised. This resulted in a 72x72 symmetric matrix of dissimilarities.

The matrix of dissimilarities was used as an input to the MDS algorithm in the SPSS package. A check on the dimensionality of the data was made by constructing the map in one dimension, two dimensions, three dimensions, and so on up to six dimensions, the

maximum allowed by SPSS. The measure of quality of fit, Stress, was computed in each case. The way in which Stress changed as the number of dimensions increased was observed, in line with the so-called “elbow” test, but no clear elbow was found, in line with the results of CATPCA. The value of Stress 1 in six dimensions was 0.075 which is described as somewhere between “good” and “fair” in Kruskal’s (1964) verbal classification.

The algorithm returned a map in a six dimensional space. This is a mathematical map. Each city council is given a set of six coordinates that locate it in the space. To visualise the map, one has to work with projections of the map on to pairs of dimensions. Not all the projections are relevant to the present situation, and it was found unnecessary to report more than four dimensions. Figure 1 shows the projection of the map (configuration) on Dimension 1 and Dimension 2.

Figure 1 about here

The first attempt to interpret a MDS configuration is always made through visual inspection. On the right hand side of the Figure 1 finds Barcelona, Sabadell, Madrid, Tarrasa, Mataró, Granada, Logroño, Gijón, Hospitalet, Valencia, and Zaragoza. These are the councils with the best level of Internet services to the citizen, and with the greater variety of services provided through the net. The list includes the largest urban conurbations. The presence in this list of five Catalan municipalities is also to be noted. This is no surprise, as Catalonia is one of the most dynamic regions in Spain. On the left hand side of the map, one finds city councils that had only a testimonial presence in the Internet in 2001: La Laguna, Fuenlabrada, Soria, Teruel, Sevilla, Avila, Cuenca, etc. Since the ordering of municipalities from left to right in Figure 1 is also the ordering in the first dimension, it appears that the first dimension measures a global index of Internet presence. The coordinate that each city is allocated in the first dimension is given in the last column of Table 2. It would be possible to rank city councils on the basis of this coordinate, and this could measure the intangible asset “service” from the external structural capital category; however, it is desirable to go beyond visual inspection and use analytical tools to confirm this diagnosis. This will be the object of the next subsection.

3.3 Interpretation of results

MDS configurations have been interpreted with two formal multivariate analysis techniques: property fitting (Pro-Fit) and hierarchical cluster analysis.

Pro-Fit is a technique that is closely related to multivariate regression analysis. This technique attempts to relate the position of a city council in the configuration to the values of the variables for this city council. The rationale of the technique is as follows. If a property of the council, such as the number of forms that can be filled in through remote access, is related to the position of the council in the configuration, a function exists that relates the value of the property to the position in the space. What form does this function take? Since properties are measured on dichotomous or polytomous scales, a linear functional relationship is not appropriate. It is better to say that the higher the value of the property, the more towards one particular direction of the configuration will be the point in the space. We are talking about ordinal relationships. Following this reasoning, 36 ordinal regressions were performed. Each variable in the data set was taken in turn as dependent in an ordinal regression; McCullagh (1980). The coordinates of the councils in the configuration were taken as dependent variables. The algorithm used was PLUM (Polytomous Logit Universal Models). Logit was used as a link function. The calculations were performed using SPSS. The results of the regressions are reported in Table 4. The table shows regression coefficients, their significance, and the values of two measures of goodness of fit. In some cases there was not enough variation in the data to obtain meaningful results. Variables for this was found were: possibility of submitting completed forms by Internet (V7), information on jobs available through the council (V19), progress of public works (V28) and information on plans or projects to popularise the use of Internet (V30). The directional vectors associated with these variables were not plotted in the configuration. The usual measure of goodness of fit in regression, R^2, is not available in ordinal regression but other pseudo coefficients of determination exist. Table 4 shows the values Nagelkerke's R, which has the property of ranging between zero and one; Hair et al (1998). Most values of this coefficient are high, with only a few falling below 0.6. Nagelkerke's R took values of 0.4 or below in the following cases: consult the progress of administrative procedures (V8), gives a complete or summary account of planning regulations (V23), and up to date pollution information (V32). These directional vectors were not plotted in the configuration.

Table 4 about here

The results of Pro-Fit were represented as oriented vectors in the configuration. Each vector shows the direction of growth of a particular property. A detailed explanation of the mathematical basis for this vectorial representation of Pro-Fit can be found in Mar Molinero (1991). The set of oriented vectors is the compass that makes it possible to interpret the MDS configuration. Pro-Fit vectors were standardised to unit length, so that the length of the projection on a particular pair of dimensions is related to the relevance of the property in the interpretation of the figure observed.

Figure 2 shows the projections of Pro-Fit vectors on Dimension 1 and Dimension 2.

Figure 2 about here

It was conjectured earlier that Dimension 1 was associated with the intangible asset "level of service". Pro-Fit confirms this view. Nearly all the directional vectors point towards the positive side of Dimension 1 in Figure 2. This is consistent with the usual finding in Principal Components Analysis, where the first component is often found to give an overall measure of the situation at hand. Some of the vectors that are strongly associated with Dimension 1 in terms of the significance of the regression coefficient for the first dimension, and in terms of the goodness of fit statistic are: usability (V36); number of forms that can be printed by remote access (V6); information on international events, conferences, festivals, etc. (V21); summary account of municipal by-laws (V22); electronic address for suggestions and complaints (V3); up to date cultural information (V5); details on administrative procedures (V9); on line payment of rates and local taxes (V10); publishes statistical information (V16); information on public transport (V13); and information on environmental management initiatives (V33). This short list of variables really accounts for most of the services and basic information that a city council should offer and, if they are offered in a user-friendly way, relations with the council are greatly simplified.

Dimension 2 was associated with the following variables on the negative side: information on how to access the city and how to leave it (V12); information on the city's history and heritage (V11); directory of telephone numbers of hospitals, emergencies, fire service,

schools, chemist, taxi services, and other (V18); web page design (V20); and information on international events, conferences, festivals, etc. (V21). All these variables are aimed at projecting the council towards the outside world, and are associated with the intangible asset that we have called “image”. Variables associated with Dimension 2 on the positive side are: information on public purchases and compulsory bidding information (V27); up to date electronic newsletter and/or City Council’s official gazette (V1); gives a complete or a summary account of municipal by-laws (V22); availability of annual accounts and public auditor’s report (V26); and information on human capital: organigram, information on civil servants, training programmes. Clearly, a city council that publishes in the Internet a newsletter, public works bidding information, by-laws, accounts, and staff information, is aiming at a high level of “transparency” in management, an intangible asset.

The second formal tool used to interpret the results was cluster analysis. The use of cluster analysis to supplement the information obtained in MDS is always recommended; Arabie et al (1987). Clusters were obtained directly from the dissimilarity matrix using Ward’s method. This method maximizes within group homogeneity and between group heterogeneity. City councils were found to divide neatly into two main groups. One cluster contained city councils that plot on the left hand side of this figure; the other cluster grouped city councils that group on the right. Each main group divided into subgroups. These subclusters could be described as strategic groups, entities that adopt similar strategies when faced with similar challenges; Hunt (1972). These subgroups have been numbered from one to five and superimposed on Figure 1. Group 1 includes Barcelona and its industrial belt (Sabadell, Hospitalet, Tarrasa and Mataro), Madrid, Granada, Logroño, Gijón, Valencia, and Albacete. This group is situated at the extreme right hand side of Dimension 1, which identifies it as having the highest score in the intangible asset “service”. These are management-oriented councils. If the two important objectives of city council management are revenue collection and service provision, they try to maximise efficiency in both by simplifying administrative relations with the public. Their strategy is to use the Internet as a one-stop-shop where citizens can pay taxes, obtain forms, fill them in, and obtain information without visiting council offices. All this adds value to the public, as it makes their life easier and reduces waiting, queuing, and red tape. Cluster 1 can be labelled as “leader”.

Cluster 2 is situated on the right hand side of Dimension 1 and at the top of Dimension 2, indicating both good service, although not as good as Cluster 1, and transparency in the

management of public services. The city councils in this cluster are: Santander, Algeciras, Las Palmas, Badajoz, Coruna, Cartagena, Palencia, Vigo, Salamanca, and Zaragoza. These councils appear to see their role as the legal representatives of local government. Their objective is to serve citizens and are keen to show that they do this well. Their strategy is based on the provision of legal, administrative and management information through the Internet. Information which is of relevance only to local citizens (bidding information, electronic newsletter, official gazette, municipal by-laws, annual accounts, public auditor's, and staff details) takes priority in this group. Cluster 2 is "transparency oriented".

Cluster 3 contains: Malaga, Vitoria, Bilbao, Tarragona, Mallorca, Gerona, Huesca, Cordoba, Badalona, Pamplona, Jerez, Lerida, Leganes, Alicante, and San Sebastián. This cluster is situated towards the right hand side of Dimension 1, at the same level of service as Cluster 2, but on the negative side of Dimension 2, an end related to provision of external information. These are councils whose objective is to create a positive external image. They use the Internet as a tool to project the city to the outside world and to inform outsiders about its merits. Variables that are salient in this group include: information on international events, access routes to the city, information on the city's history and heritage, directory of telephone numbers, and they do this by making an effort into providing good web page design. These are "externally oriented" councils.

Cluster 4 contains a group of 22 councils that have made a start on the use of the Internet. These could be described as "late comers". In Cluster 5 the use of Internet is merely testimonial. These last group could be described as "unwired".

We have examined the way in which Spanish city councils use the Internet to offer municipal services, and we have identified five strategic groups but, are we just observing the fact that some councils have more resources than others and can devote more effort to technology? Is this a money related issue, or is it a matter of strategy? One could conjecture that if this was a resource related issue, councils with larger populations would be salient in their use of the Internet and in the services they provide since in Spain municipal resources are related to the size of the population served. Population was used as an external property and Pro-Fit analysis performed. Some effect was found, as Dimension 1 was found to have a significant regression coefficient. However, the explanatory power of the regression was very poor, with adjusted R^2 taking the value 0.17. In general, it appears to be true that large councils are more involved in the provision of

services through the Internet, but there are many small councils that appear to be making an important effort; an example would be Logrono. The converse is also true, one would have expected a large council such as Sevilla to have made much more of an effort in using the Internet.

4. CONCLUSIONS

Many of the objectives of public administrations, many of the resources they use, and even much the output they generate are intangible. The Public Sector is, therefore, an ideal framework for the application of the ideas related to Intellectual Capital theory. Notwithstanding the importance of financial information, it has been argued that a good management of intangible assets may help a public sector institution to achieve its objectives. Four types of intangible assets of relevance to the Public Sector have been identified: internal organization, external structural capital, human capital, and social and environmental commitment.

It has been argued that this requires a methodology to identify and measure the importance of such intangible assets in management. Multidimensional Scaling (MDS) methods have proposed as such a methodology, since relevant data is of a multivariate nature, which requires the tools of multivariate statistical analysis. MDS can deal with qualitative information and visualises the main characteristics of the data. Other tools of multivariate statistical analysis can be used to supplement the basic MDS algorithm and throw light on their interpretation.

This study has concentrated on the intangible asset “external structural capital”, as reflected in the use of the Internet for the provision of services to the public by Spanish city councils. Data was obtained from 72 councils on 36 relevant characteristics obtained from the Internet.

The technique made it possible to identify five strategic groups of councils, and three intangible assets: service, image, and transparency. The position on the MDS configuration of each council was associated with the saliency of each of these intangible assets.

It was found that the effort devoted to the provision of council services via the Internet is only vaguely related to resources available in the council. This suggests that to provide council services by remote link, and thus removing red tape, requires the know-how, the culture and the willingness to make an effort to do so, and these are intangible assets related to internal organisation.

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Internal organization	*External Structural Capital*	*Human Capital*	*Social and environmental commitment*
• Ability to innovate • Know How • Structural organisation • Corporate culture • Links and contacts	• Service • Image • Transparency	• Aptitudes of civil servants • Permanent training • Conditions of service	• Social commitment • Environmental commitment

Table 1. Clasification of intangible assets in the Public Sector

City	*Population*	*Web address*	*Ranking*
Barcelona	1,503,451	www.bcn.es	3.9
Sabadell	184,859	www.ajsabadell.es	3.6
Madrid	2,879,052	www.munimadrid.es	3.6
Tarrasa	168,695	www.ajterrassa.es	3.5
Mataró	104,095	www.infomataro.net	3.1
Granada	244,767	www.granada.org	3.1
Logroño	127,093	www.logro-o.org/	3.0
Gijón	267,980	www.ayto-gijon.es	2.7
Hospitalet	247,986	www.l-h.es/	2.6
Valencia	739,412	www.ayto-valencia.es/	2.5
Zaragoza	603,367	www.ayto-zaragoza.es/azar/	2.2
Albacete	147,527	www.amialbacete.com/	2.1
Alicante	272,432	www.alicante-ayto.es	2.1
Bilbao	357,589	www.bilbao.net/	1.9
Vigo	283,670	www.vigo.org	1.7
Córdoba	311,708	www.ayuncordoba.es/	1.6
Pamplona	180,483	www.pamplona.net	1.6
Cartagena	177,709	www.ayto-cartagena.es	1.5
Vitória	217,154	www.vitoria-gasteiz.org/	1.5
Jerez	182,660	www.webjerez.com	1.5
La Coruna	243,402	www.ayutolacoruna.es/castellano/	1.4
Malaga	530,553	www.ayto-malaga.es	1.2
Leganés	173,163	www.leganes.org	1.1
Lérida	112,207	www.paeria.es	1.0
Salamanca	158,720	www.helcom.es/aytosalamanca/	0.8
San Sebastian	179,208	www.donsnsn.es	0.7
Mallorca	326,993	www.a-palma.es/	0.5
Palencia	80,332	www.palencia.com/ayuntamiento/	0.4
Huesca	45,627	www.ayuntamientohuesca.es/	0.2
Girona	72,682	www.ajuntament.gi	0.1
Burgos	162,802	www.aytoburgos.es	0.1
Ceuta	73,704	www.ciceuta.es	0.1
Elche	193,174	www.ayto-elche.es/	0.0
Badalona	209,635	www.aj-badalona.es	0.0
Tarragona	113,016	www.tgna.altanet.org/	0.0
Algeciras	103,106	www.ayto-algeciras.es	0.0
Santander	184,165	www.ayto-santander.es/	-0.2
Las Palmas	354,757	www.laspalmasgc.org	-0.4
Marbella	101,144	www.pgb.es/marbella/html/marbella.html	-0.5
Cádiz	142,449	www.cadizayto.es/	-0.5
León	139,809	www.aytoleon.com	-0.6
Oviedo	200,453	www.ayto-oviedo.es/	-0.6
Murcia	353,504	www.ayto-murcia.es	-0.7
Badajoz	136,613	www.aytobadajoz.es/	-0.7
Zamora	64,906	www.ayto-zamora.com/	-0.7
Valladolid	319,998	www.ava.es/main.html	-0.8
Huelva	140,583	www.ayuntamientohuelva.es	-0.8
Almería	169,027	www.a2000.es/almeria	-0.9

Alcorcón	142,048	www.ayto-alcorcon.es	-0.9
Castellón	139,712	www.ayuncas.es	-1.2
Alcalá de Henares	164,463	www.alcala.henares.es	-1.3
Orense	109,120	www.ourenseconcello.com/	-1.3
Segovia	54,175	www.ctv.es/aytosego	-1.4
Sta. Coloma	120,802	www.gramenet.diba.es	-1.5
Toledo	67,617	www.ayto-toledo.net/	-1.5
Getafe	145,371	www.ayto-getafe.org	-1.7
Jaén	109,247	www.aytojaen.es/	-1.9
Móstoles	195,351	www.ayto-mostoles.es	-2.0
Lugo	87,480	www.concellodelugo.org/guiacidade/	-2.0
Pontevedra	74,139	www.concellopontevedra.es/	-2.0
Melilla	56,929	www.camelilla.es	-2.1
Ciudad Real	61,138	www.ayuntamientociudadreal.net	-2.1
Guadalajara	69,959	www.guada.com	-2.1
Cáceres	78,614	www.ayto-caceres.es/	-2.3
Sta Cruz de Tenerife	213,050	www.accionmm.com/santacruz/	-2.4
Cuenca	45,100	www.cuenca.org/	-2.9
Ávila	47,682	www.ayuntavila.com/	-2.9
Sevilla	701,927	www.ayunt-sevilla.es/	-2.9
Teruel	30,047	www.teruel.net/	-2.9
Soria	34,045		-2.9
Fuenlabrada	171,173		-2.9
La Laguna	127,945		-2.9

Table 2. Spanish municipalities in the study

	Definitions of variables used	*Label*	*Range*
V1	Up to date electronic newsletter and/or City Council's official gazette	news	0-2
V2	Electronic mailing list to suscribe to news and information. Possibility of receiving personalised information	enews	0-2
V3	Electronic address for suggestions and complaints. Individualised by sector of activity or department	complaints	0-2
V4	General information on buses, museums, libraries, etc.	info	0-3
V5	Up to date cultural information: concerts, theatre, cinema, music, children's activities, dance, etc.	culture	0-5
V6	Number of forms that can be printed by remote access: electoral register, parking permit applications, etc.	forms	0-7
V7	Possibility of submitting completed forms by Internet	eforms	0-1
V8	The citizen can consult the progress of administrative procedures such as permissions, fines, objections, and other.	steps	0-1
V9	Details are given on administrative procedures such as applications, complaints, planning permission and others	howto	0-2
V10	On line payment of rates and local taxes	tax	0-2
V11	Information on the city's history and heritage	history	0-2
V12	Information on how to access the city and how to leave it	travel	0-2
V13	Information on public transport: bus routes, timetables, itineraries, and maps	bus	0-4
V14	Map of the city and/or A to Z street guide	map	0-2
V15	Wheather information: historical summary or on-line up to date	weather	0-2
V16	Publishes statistical information on various aspects of the municipality	statistics	0-3
V17	Directory of telephone numbers and/or email addresses of the council	directory	0-2
V18	Directory of telephone numbers of hospitals, emergencies, fire service, schools, chemist, taxi services, and other	telephone	0-7
V19	Information on jobs available through the council. Internet applications	employ	0-2
V20	Web page design. Languages. Multimedia.	look	0-4
V21	Information on international events, conferences, festivals, etc.	external	0-3
V22	Gives a complete or a summary account of municipal by-laws	law	0-2
V23	Gives a complete or summary account of planning regulations	ground	0-2
V24	Information on agenda and dates of council meetings	assembly	0-1
V25	Information on city budget and amount already committed	budget	0-2
V26	Availability of annual accounts and public auditor's report	audit	0-2
V27	Information on public purchases. Compulsory bidding information	purchases	0-1

V28	Progress of public works	works	0-1
V29	Presentation of City's strategic plan	plan	0-1
V30	Information on plans or projects to popularise the use of Internet	Internet	0-1
V31	Information on human capital: organigram, information on civil servants, training programmes	human	0-3
V32	Up to date pollution information: air contamination, water, noise, pollen counts	pollution	0-3
V33	Information on environmental management initiatives: percentage refuse recycled, energy savings, water losses, sewage treatment, etc.	environment	0-4
V34	Information on grants, funds for socially desirable projects	grant	0-1
V35	Information on social projects: youth hostels, help for drug addicts, the elderly, the homeless, etc.	social	0-4
V36	Web site usability: search engines, map of the site, FAQ, "not found" page, navigation bar, links, and others	usability	0-6

Table 3. Variables used in the study

	Directional cosines						χ	*R*
	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6		
V1	0.53	0.44	0.58	-0.27	-0.35	0.00	48.64	0.575
	(24.382)**	(4.781)*	(6.039)*	(1.491)	(2.449)	(0.453)		
V2	0.09	0.33	0.78	0.23	0.19	0.44	21.38	0.485
	(1.347)	(2.298)	(6.590)*	(1.253)	(1.147)	(1.935)		
V3	0.35	0.03	-0.64	0.19	-0.20	-0.63	58.00	0.637
	(25.458)**	(0.045)	(13.119)**	(1.926)	(0.758)	(11.187)**		
V4	0.73	-0.41	-0.13	0.09	0.53	0.00	58.78	0.660
	(19.199)**	(3.449)	(0.253)	(0.178)	(3.840)	(0.000)		
V5	0.70	-0.04	0.11	-0.47	0.27	0.45	87.41	0.782
	(25.799)**	(0.091)	(0.506)	(8.465)**	(2.951)	(6.247)*		
V6	0.66	0.15	-0.33	0.02	-0.31	0.58	71.35	0.660
	(37.029)**	(0.876)	(3.720)	(0.019)	(2.953)	(8.134)**		
V7	0.22	0.06	-0.35	0.04	-0.19	0.89	95.27	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	-		
V8	0.63	-0.51	-0.12	0.22	-0.19	0.50	10.86	0.401
	(2.809)	(1.539)	(0.193)	(0.433)	(0.230)	(0.890)		
V9	0.63	0.27	0.54	0.11	0.23	0.42	63.85	0.747
	(15.900)**	(3.100)	(5.855)*	(0.328)	(1.255)	(3.456)		
V10	0.57	0.29	-0.36	0.16	-0.47	-0.47	66.69	0.719
	(22.537)**	(2.815)	(4.125)*	(0.869)	(5.955)*	(4.816)*		
V11	0.28	-0.63	0.03	-0.07	0.71	0.11	54.51	0.764
	(10.704)**	(12.680)**	(0.049)	(0.552)	(6.536)*	(1.061)		
V12	0.22	-0.78	-0.06	0.18	0.50	-0.23	68.81	0.703
	(16.431)**	(21.905)**	(0.349)	(2.529)	(15.047)**	(3.423)		
V13	0.58	-0.32	-0.13	0.64	0.27	0.24	47.92	0.541
	(25.613)**	(2.472)	(0.366)	(7.512)**	(1.371)	(0.907)		
V14	0.51	0.06	0.82	0.07	-0.23	-0.03	60.79	0.650
	(26.893)**	(0.163)	(13.033)**	(0.159)	(1.550)	(0.022)		
V15	0.26	0.05	-0.65	-0.60	0.26	-0.28	43.62	0.562
	(11.267)**	(0.134)	(12.663)**	(11.490)**	(2.765)	(2.959)		
V16	0.60	-0.02	0.42	-0.65	-0.09	0.16	53.65	0.569
	(31.373)**	(0.016)	(3.579)	(8.523)**	(0.192)	(0.553)		
V17	0.51	0.04	-0.19	-0.79	-0.28	0.00	59.43	0.653
	(19.894)**	(0.029)	(0.660)	(7.826)**	(1.317)	(19.544)**		
V18	0.37	-0.60	-0.22	-0.21	-0.61	-0.19	71.85	0.663
	(28.182)*	(16.000)**	(2.261)	(2.266)	(16.261)**	(1.714)		
V19	0.27	0.90	-0.33	0.09	0.00	0.02	97.07	1.000
	(0.000)	-	(0.000)	(0.000)	-	-		
V20	0.45	-0.72	-0.42	-0.17	-0.17	-0.20	42.80	0.475
	(24.137)**	(13.031)**	(4.347)*	(0.704)	(0.652)	(0.767)		
V21	0.73	-0.50	-0.39	0.25	-0.02	0.08	67.87	0.657
	(38.081)**	(6.208)*	(3.235)	(1.371)	(0.011)	(0.132)		
V22	0.67	0.54	-0.12	0.09	-0.46	-0.15	92.49	0.826
	(24.919)**	(10.082)**	(0.576)	(0.348)	(7.495)**	(0.885)		
V23	0.45	-0.46	-0.17	0.22	-0.67	-0.26	16.23	0.277

	(8.234)**	(2.325)	(0.331)	(0.458)	(3.218)	(0.506)		
V24	0.25	-0.12	-0.10	-0.36	-0.87	-0.16	55.42	0.904
	(1.553)	(0.998)	(1.526)	(1.950)	(1.785)	(1.467)		
V25	0.59	-0.09	0.26	0.21	0.62	0.38	38.72	0.604
	(11.711)**	(0.201)	(1.630)	(0.789)	(5.723)*	(1.770)		
V26	0.34	0.34	0.76	-0.40	0.12	-0.12	21.22	0.427
	(5.881)*	(1.226)	(4.460)*	(1.631)	(0.164)	(0.100)		
V27	0.42	0.48	-0.08	0.70	-0.13	-0.29	72.78	0.898
	(4.965)*	(5.937)*	(0.376)	(4.069)*	(0.765)	(2.210)		
V28	0.67	-0.57	0.11	0.43	0.11	0.14	24.94	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	-	-		
V29	0.25	-0.08	0.45	-0.82	0.18	0.17	57.72	0.928
	(0.305)	(0.265)	(0.763)	(0.676)	(0.844)	(0.943)		
V30	0.01	0.27	0.74	-0.39	-0.48	0.05	41.30	1.000
	(0.000)	-	-	-	-	-		
V31	0.49	0.32	-0.23	-0.11	0.61	-0.46	35.50	0.494
	(15.590)**	(2.773)	(1.475)	(0.325)	(7.588)**	(3.189)		
V32	0.64	-0.09	-0.49	0.18	-0.48	-0.29	18.59	0.323
	(10.180)**	(0.076)	(2.213)	(0.253)	(1.438)	(0.531)		
V33	0.44	-0.08	0.19	-0.81	0.32	0.00	53.17	0.571
	(25.331)**	(0.220)	(1.256)	(15.655)**	(3.460)	(1.372)		
V34	0.22	-0.31	0.34	0.77	-0.35	-0.14	88.10	0.941
	(4.310)*	(2.860)	(4.633)*	(2.753)	(1.555)	(1.145)		
V35	0.47	-0.38	-0.49	0.07	0.20	-0.60	76.26	0.728
	(25.265)**	(6.499)*	(7.281)**	(0.257)	(11.251)**	(10.236)**		
V36	0.68	-0.10	-0.16	0.00	0.37	-0.61	54.81	0.549
	(39.332)**	(0.259)	(0.565)	(0.000)	(2.751)	(6.249)*		

** Significant at the 0.01 level

* Significant at the 0.05 level

Table 4. Pro-Fit Analysis. Ordinal regression results

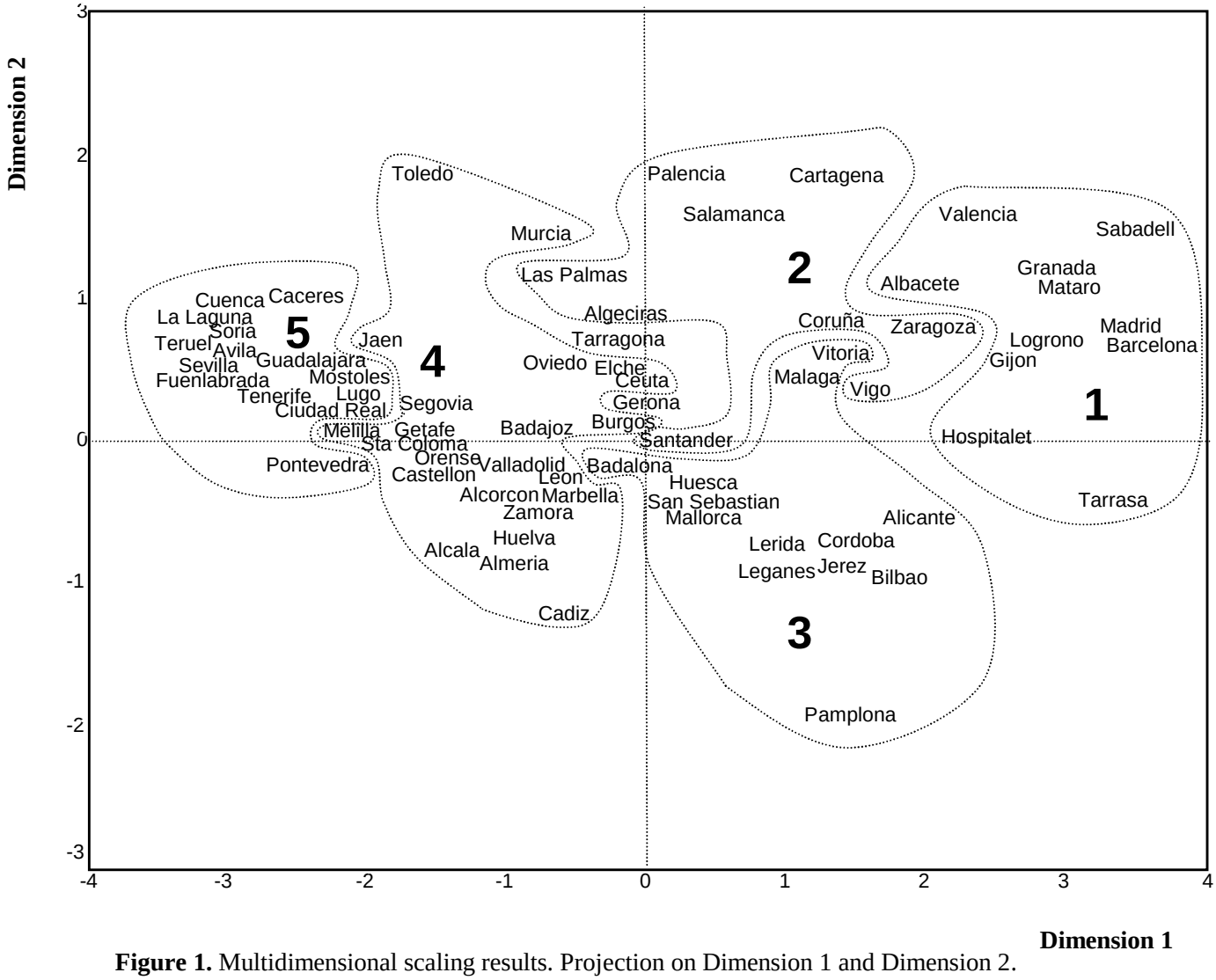

Figure 1. Multidimensional scaling results. Projection on Dimension 1 and Dimension 2.

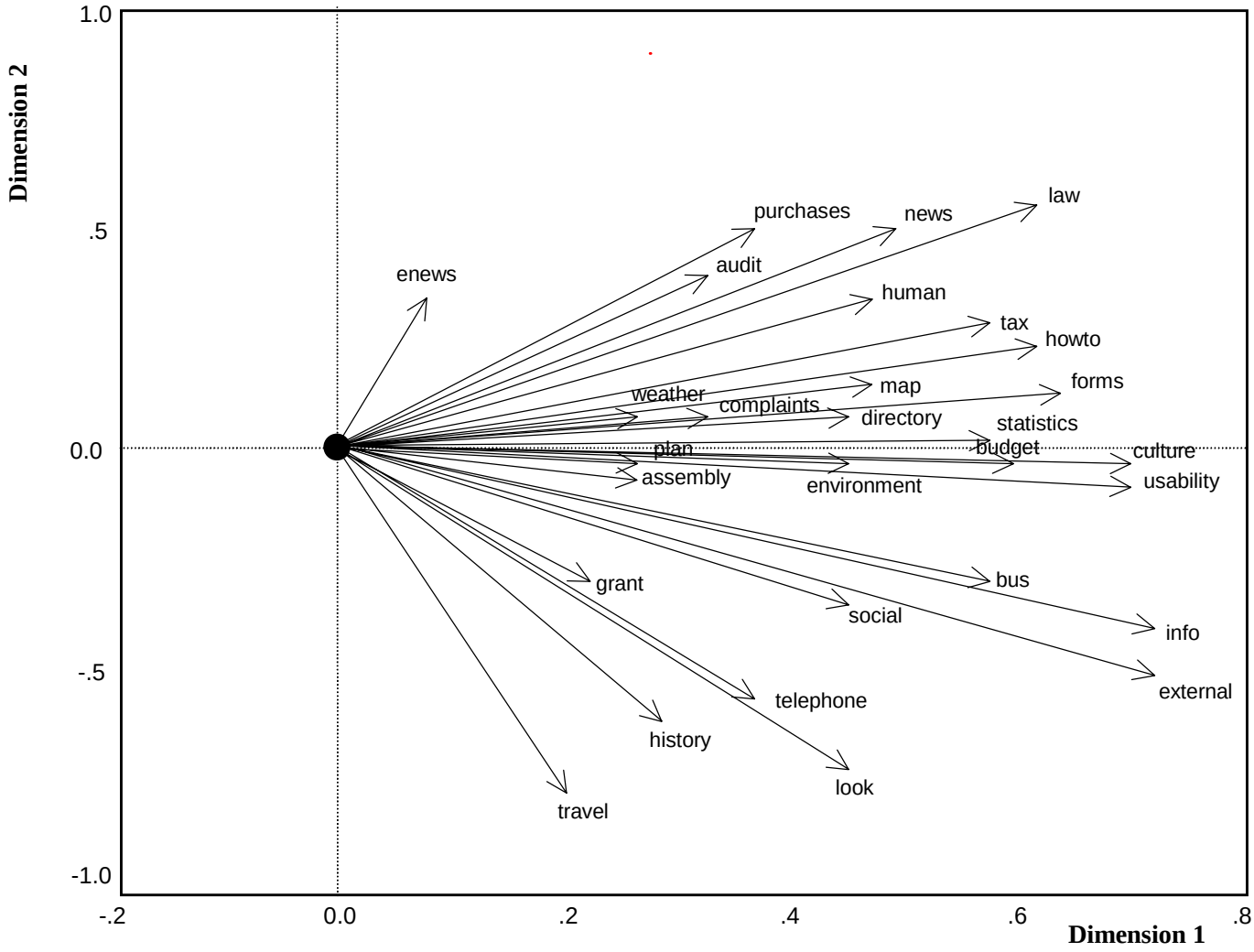

Figure 2. ProFit Analysis. Vectors for each variable. Dimension 1 and 2.