DOCTORAL THESIS

Title	**What groups of factors do senior executives believe affect their use of executive information systems?**
Author	Josep Lluís Cano Giner
Program	PhD in Business Administration
University	Escola Tècnica Superior d'Enginyeria Industrial de Barcelona
Department	Department of Management
Supervised by	Dr. Marta Díaz Boladeras Dr. Vicenç Fernández Alarcón

UPC – Departament of Management
Campus SUD - Edif. H
AVDA. DIAGONAL, 647
08028 Barcelona
Spain

To Marta, Arnau and Júlia

Acknowledgements

Thanking all those who have helped us reach where we are today is always a difficult task. I hope not to leave anyone out along the way. If I do, it is clearly an error of omission.

I have been fortunate to be able to dedicate myself to something I truly enjoy: teaching. This is the primary reason behind my finally writing this thesis. I feel that I have dedicated myself to this field because I found professors who helped me understand the importance of education while I was a student. From some, I learned what I had to do; from others, what I should avoid. Thanks to all of you. I studied at La Salle Condal (Barcelona), ESADE Business School, Universitat Politécnica de Catalunya, and Harvard Business School.

I would also like to give special mention to the IT Management Department at Copenhagen Business School who welcomed me during my international stay there. Thank you Janni, Leif, Niels, Jan, Ravi, Suzanne, Heidi…

I have also been fortunate to have magnificent colleagues; with some, our relationship has developed even beyond the professional realm. I learn something new from you every day: Xavier, Jordi, Paco, Josep Maria, Xari, Núria, Ricard, Gerard, Mar, Pere, Joan, Enric, Tamiko, Jaime, Enric and Rodrigo. Thank you.

I have also learned something new from many other people I work with on a daily basis: Dolors, Marta, Yolanda, Fàtima, Marian,…

And, of course, I'd also like to thank my family who put up with me throughout the entire thesis preparation process.

Nor can I forget Dr. Marta Díaz Boladeras and Dr. Vicenç Fernández Alarcon, both of whom accompanied me on the long road culminating in this thesis.

I also need to thank the Dean and Vice Deans of ESADE, Dr. Alfons Sauquet, Dr. Manel Peiró and Dr. Jonathan Wareham, for their invaluable help during this process. Lastly, I would also like to thank Dr. Eugènia Bieto, ESADE Director General, and Ramón Aspa, Deputy Director General, for their support.

To all of you, my most sincere thanks.

Contents

Index of Tables

Index of Figures

What groups of factors do senior executives believe affect their use of executive information systems?

1. Introduction

In a highly competitive and turbulent environment, executives need more efficient ways to analyze their companies, markets and competitors. The aim is to help their organizations become more competitive and, as a result, survive the changes taking place around them. Executive Information Systems (EIS) can help executives access the internal and external data they need to be able to make the right decisions and achieve their organizations' objectives. As Ikart (2005) indicates, a significant number of organizations have invested heavily in EIS to improve the performance gain of executives' roles. If senior executives adopted these systems more widely, they would probably increase their productivity.

The beginnings of the relationship between Information Technologies,[1] executives and decision-making can be traced back to the times of the first computers. However, executives have been reluctant to use IT systems to make decisions. Scholars have provided several arguments over the years to explain this lack of computer use among executives, including: poor keyboard skills, a lack of training and experience in computer use, and even concern about their status, as they felt that using a computer was not a part of their job (Mohan, Holstein, & Adams, 1990). Executives also have little time to play around with new technologies, they are reluctant to use the technology due to personal computer anxiety, they lack IT skills and proficiency and dedicated staff is not available to answer their queries (Seyal & Pijpers, 2004). In addition, another set of reasons refers to the alternative between system flexibility or simplicity, that is, if systems were inflexible or overly-simple, executives perceived them as adding no value, but there are other cases in which

[1] In Spain, most people commonly talk about "Information and Communication Technologies," but "Information Technology" is more common abroad, generally including *Communication Technologies* in the term. In this thesis I use "IT."

executives have overcome these obstacles, for example, executives at Lockheed-Georgia (Houdeshel & Watson, 1987).

In the mid-1950s, most scientists believed that computers would have a notable impact on scientific calculations (e.g., in astronomy and the military sphere). A few (including Russell Ackoff, John Diebold and J.W. Forrester) agreed that computers would, in the then immediate future, revolutionize the work of executives in the policy area, strategy and decision-making as Drucker (1998) said. The possibility that computers and applications would affect the way executives worked was already anticipated. Although computers existed before 1965, this date marked an unprecedented change when IBM presented its System/360 family of products. At that moment, scientists began to ask themselves how computers might help humans improve their decision-making. Collaboration between scientists at the Carnegie Institution, together with Marvin Minsky at the Massachusetts Institute of Technology and John McCarthy at Stanford University, developed the first cognitive computer models, serving as the embryo for Artificial Intelligence (Buchanan & O'Connell, 2006).

When observing the current situation within organizations, we can affirm that a large number of executives have adopted these types of decision-making solutions. The rise and increasing use of these tools have led to different studies analyzing why EIS systems are adopted within organizations. The common objective of these studies has been to determine which factors have to be considered when implementing an EIS within a given organization for the project to be successful.

The key conclusions of these studies include: Information Systems departmental support for EIS projects is directly related to the EIS system's success, and both Information Systems' and vendor/consultant's support for EIS projects are influenced by top management's support; in addition, high levels of support from a company's senior executives indirectly influence EIS success by creating a supportive context for the Information Systems organization and vendors/consultant in a firm's EIS efforts (Bajwa, Rai, & Brennan, 1998). Other studies have determined that there are higher levels of

environmental dynamism, heterogeneity, and hostility in firms that have adopted EIS compared to firms not using an EIS, and a firm's size determines the EIS capabilities implemented (support for managerial communications, coordination, control, and planning) (Bajwa, Rai, & Ramaprasad, 1998). Similarly, there is a relation between the increase of EIS capabilities (from decision support to collaboration support) and environmental uncertainty, Information Systems support and top management support, but not with firm size (Rai & Bajwa, 1997); and, the variables that contribute to the success of an EIS can be categorized as those that contribute to successful EIS development (the most important are: executive leadership and continued involvement in the development process) and those that contribute to successful ongoing EIS operations (the most important are those that affect the executives and their work) (R. K. Rainer & Watson,1995a). Other scholars have determined that the factors that contribute to create new EIS systems are: pressures to improve corporate performance while simultaneously controlling the growth in the number of staff who support key executives, widespread knowledge transfers about EIS systems from publications and conferences, and easier to use, less expensive, and more powerful technologies to present information to users (Young & Watson, 1995).

Executive Information Systems, like any other software, are designed to be used directly by users, in this case, executives. Salmeron (2002) demonstrated an increase in direct EIS use by executives in two studies on large Spanish firms. This use increased from 69% to 75.9% in a study carried out in March 1999 compared to another in February 2001. Salmeron argued that this increase was due to the fact that Spanish executives in these firms had become aware of the importance information systems have and that new generations which were more likely to use these EIS were reaching executive positions.

2. Motivations behind this thesis

i. Research object and subjects

Senior executives are not easy to study due to their reluctance to participate in research projects dedicated to them. As such, these executives' traits as well as research techniques have to be carefully considered to make this research possible.

There are few studies readily available on senior executives. For example, when searching for the topic "senior executives" in the Web of Science[2] (part of the Web of Knowledge, accessed (7/6/12), a total of 573 entries addressed all the topics dedicated to these executives. As such, studies dedicated to "senior executives" are especially relevant due to the difficulty in accessing these professionals, the relevant role that they have in organizations, the differences that they have with respect to other people in an organization as well as the reduced number of studies available on them.

Scholars have also carried out various studies on the factors which affect the success of EIS systems, though they do not examine how these factors affect the ways executives actually use these systems. Rainer and Watson (1995) distinguish between the EIS development phase and its posterior use. Their study includes executives, EIS manufacturers and implementers. These authors declare that executives' opinions are the most important and that they sometimes differ from those of the salesmen and consultants. They conclude that executives have to assume a more active role in EIS development and that the most important factor in EIS use is meeting executives' needs. However, Rainer and Watson do not analyze cases in which executives find EIS systems already implemented upon joining their organizations. Their study raises an important question, that is, if executives' opinions are the most important, why not only ask them?

In a later study, Bajwa, Rai and Brennan (1998) analyze factors related to support from management, the IT department and salesmen and/or consultants.

[2] *Web of Science* ® provides researchers, administrators, faculty, and students with quick, powerful access to the world's leading citation databases. Authoritative, multidisciplinary content covers over 12,000 of the highest impact journals worldwide, including Open Access journals and over 150,000 conference proceedings. (http://thomsonreuters.com website, accessed July, 2012)

They conclude that support from senior management and salesmen/consultants has no effect on an EIS system's success, though they admit that one of the limits of their study is the reduced number of participants in their research.

As discussed above, research does exist analyzing the causes of EIS success or failure, but very few studies have focused on EIS adoption by executives and on the factors or series of factors which lead executives to use these types of information systems developed especially for them.

The objective of this thesis, then, is to uncover which factors senior executives feel affect their use of EIS, compare the factors they propose to those mentioned in other studies related to EIS or other IT artifacts to thus determine the factors' importance, and group the factors which affect or may affect senior executives.

Improving our awareness of these factors and how they can be grouped together may serve to help professionals manage EIS projects better and achieve better results in terms of their adoption and use by senior executives to help improve their decision making and achieve their organizational goals.

ii. Scientific motivations

Among all the different theories developed in the Information Systems area and, concretely, those related with the prediction of an information system's acceptance the Technology Acceptance Model or TAM (F. D. Davis, 1989) is the most utilized. TAM is an adaptation of the Theory of Reasoned Action (TRA) to the IT field. TAM suggests that a user's behavioral intention (BI) is the factor which allows us to better predict how he or she actually uses the system. This intention is determined by the user's attitude towards the system's use. TAM posits that perceived usefulness and perceived ease of use determine an individual's intention to use a system, this 'intention to use it' serving as a mediator of actual system use. Perceived usefulness is also seen as being directly impacted by a system's perceived ease of use. Researchers have

simplified TAM by removing the attitude construct found in TRA from the current specification (Venkatesh, Morris, Davis, & Davis, 2003).

In their meta-analysis of TAM, Yousafzi, Foxall and Pallister (2007a) indicate that “according to Davis (1989), one of the key purposes of TAM was to provide a basis for tracing the impact of factors on internal beliefs, i.e., Perception of Usefulness and Perception of Ease Of Use, and to link that to actual use.” This link to actual use was also found by Wöber and Gretzel (2000) who affirmed that “the results indicate that the actual use of the system is strongly dependent on perceived ease of use and perceived usefulness.”

Yousafzi, Foxall and Pallister (2007a) also reported that:

- There were only 5 studies related to managers or executives, EIS or DSS (Decision Support Systems), out of 145 studies, and that
- Only one of these 5 studies analyzed the factors. This study was carried out by Pijpers, Bemelmans, Heemstra and van Montfort (2001) and analyzes the underlying factors, though they propose grouping these factors as follows:

  > A review of the relevant literature also suggests [that] the external, independent variables can be categorized in: individual characteristics, organizational characteristics, task-related characteristics, and characteristics of the IT Resource.

I found one more study in a more detailed search on EIS and TAM. This study was undertaken by Ikart (2005) who proposed grouping these factors as follows:

> The variables used from Triandis’ framework (1979) in this paper are: Social factor, Habits and Facilitating conditions.

Both analyze the underlying factors though they propose two different sets of criteria with which to group them.

Lee, Kozar and Larsen (2003) conclude their article by arguing that there are still various areas which need to be further examined, including the

incorporation of more variables and exploring environmental conditions. One of these areas is precisely the scientific motivation behind this thesis, namely, to contribute to clarify the importance different factors have in understanding IT use by a specific group of users and to confirm the need to carry out prior qualitative studies before studying the factors between a given type of user and a given type of IT solution. This thesis also aims to contribute to improve one of the most studied theories in the IT field.

iii. Methodological motivations

The methodology proposed to group these factors together is Concept Mapping (W. M. K. Trochim, 1985; W. M. K. Trochim, 1989b). Concept Mapping is a general framework for structured conceptualization and shows how specific conceptualization processes can be devised to assist groups in the theory and concept formation stages of planning and evaluation. This process usually consists of 6 steps as we shall see in Chapter 4 below. Another of this thesis' purposes is to apply the Concept Mapping method to senior executives. However, we shouldn't confuse this methodology with "concept maps." The latter were developed in 1972 in the course of Novak's research program at Cornell.

This research is a novel example using Concept Mapping. In addition, it may also provide us with an example on applying this methodology with ITs and senior executives.

The structure of this thesis is divided into five main sections after the introduction and the discussion on motivations: the conceptual framework, research methodology, analysis and findings, reflection and discussion, references, and annexes.

The objective of the conceptual framework section is to define these senior executives, EIS and TAM; as such, it is divided into three main subsections.

3. Conceptual framework

a. Senior executives

Executives play an important role in organizations. They occupy the higher positions in firms and, most fundamentally, they decide on the future of their organizations. They need information to make these decisions, and EIS systems are the IT platforms designed to facilitate these decisions.

There are different types of executives within organizations, but the literature distinguishes "senior executives" from others. Seeley and Targett (1997) propose the following definition: "an executive who is concerned with the strategic direction of their organization's business." They add that the senior executive "is in a position to influence significantly the strategic decision-making processes for their function and/or the organization; has substantial control and authority above how resources are deployed; is in a position to influence the strategic direction of the Business of their function/organization; may have other senior managers reporting to him or her."

Numerous studies in the literature analyze the relationship between executives and information systems. In these studies, executives are also considered different types of users based on their work, status, roles, skills, etcetera. Different authors refer to executives in many different ways: federal decision makers; legislators and members of their office support staff; staff members of selected committees that deal with advanced technologies on a routine basis; and administrators of Executive Branch agencies (Ault & Gleason, 1998; Brady, 1967; Buchanan & O'Connell, 2006; Cano Giner, 2011; Elbeltagi, McBride, & Hardaker, 2005; Hasan & Lampitsi, 1995; Marginson, King, & McAulay, 2000; Mawhinney & Lederer, 1990; Pijpers et al., 2001; Pijpers & van Montfort, 2006; Puuronen & Savolainen, 1997; M. Seeley & Targett, 1999; Seyal & Pijpers, 2004; Stenfors, Tanner, Syrjanen, Seppala, & Haapalinna, 2007; Vlahos & Ferratt, 1995).

Senior executives are a special group which need to be studied. Seyal and Pijpers (2004) declare that “senior executives’ use of ITs is purely optional and [they] are unlikely to be highly influenced by peers or subordinates”, adding, “it is therefore important that they should be treated as a special group due to the nature and type of duties performed.”

I concur that these are the reasons why we should study senior executives.

b. What is an EIS?

Executive Information Systems are a type of Decision Support System (DSS) based on providing organizational executives with data (Fitzgerald, 1992). They can, however, be used at different executive levels. They are flexible tools which provide broad, in-depth information and which have analytical capabilities supporting a wide range of executives’ decisions (Houdeshel & Watson, 1987) (Rockart & DeLong, 1988). EIS systems are designed to make the data from lower areas within the organization, essentially, data from transactional systems, easy to use and available to executives for these to be able to make decisions on a highly informed and qualified basis (Stevenson, 1994).

EIS have transformed enormously since 1976 when Ben Heineman, Northwest Industries CEO, began using a terminal and a database to monitor and plan the growth of the company’s nine business units (Rockart & Treacy, 1982).

Watson, Rainer and Koh (1991) define EIS as computer-based systems which provide executives easy access to internal and external data that are essential for their critical success factors (Rockart, 1979). A review of key studies on EIS characteristics offers the following list of EIS traits (Burkan, 1988; Friend, 1986; Kogan, 1986; Zmud, 1986):

a. They are designed for each individual executive.
b. They extract, filter, compress and track critical information.

c. They provide real-time access, analyze trends, generate exceptions reports and enable drilling down from the aggregate level to details.
d. They access and incorporate a wide range of internal and external data.
e. They are very easy to use and require very little training, if any, for their use.
f. They are used directly by the executives, without the need for intermediaries.
g. Data are presented in graphic form, in tables and/or in text format.

The literature also makes an important distinction between these EIS systems and Executive Support Systems (ESS). According to Hung (2003), these two types of systems should not be confused, as ESS provide the following capacities in addition to the traits described above:

a. They permit electronic communications (for example, e-mail, computer-based conferences and text processors).
b. They have data analysis capacities (for example, spreadsheets and consulting language); and
c. They include organizational tools (for example, a calendar).

EIS data sources are also diverse in origin, including, for example, the company's transactional systems, financial data systems, sales data systems, text files and manually introduced data. All these are internal sources. However, a fundamental trait defining EIS systems is that they also gather external data. As such, they should have access to sources such as news items, legal regulations and analyses on the competition (Young & Watson, 1995).

This external information is critical in many industries. For example, John C. Wilson, CFO at Hardee's Food Systems (an American fast food company with more than 2 billion dollars in sales in 1985), argued that, when he analyzed the company's sales in a geographic area where profits were worse than in other areas, he discovered that these results were due to inclement weather in that area over the timeframe analyzed (Madlin, 1986).

EIS were increasingly developed in the second half of the 1980s due to the rise of new technologies: client/server systems, communications networks, graphic interfaces, multidimensional models, etc. However, increased market turbulence was the decisive factor, instilling the need for executives to have systems available allowing them to access prepared data. These systems represented a significant aid in their decision-making and in providing them the information they needed to draft their companies' strategies.

Today, EIS systems access information stored in data marts or data warehouses. The latter enable users (senior executives included) to access cleaner, more consistent and integrated data, thus allowing users to find more and better quality data. Many EIS systems enable users to access data through their web browsers which also give them access to data found on their companies' intranets and Internet, in general. In addition, some EIS systems also include On-Line Analytical Processing (OLAP) functions, permitting users to analyze data at both the aggregate and detailed levels.

i. Methods to provide information to the EIS

Rockart's Critical Success Factor theory (1979) was fundamental to the development of EIS. These critical success factors refer to a limited number of areas. Achieving satisfactory results in these areas implies ensuring competitive performance for a given individual, his/her department or the organization as a whole.

In 1979, John F. Rockart published his article entitled "Chief executives define their own data needs" in which he analyzed different methods to provide data to executives. These methods included the product-based technique (aggregating transaction data by products or product lines), the null approximation method (as executives' work is dynamic, it cannot be predetermined), key indicator system (indicator selection, exceptions reports and their visualization), and analysis of the data that all executives in an organization need (non-existing data in the process are then added). Lastly, Rockart concluded by proposing

the Critical Success Factors (CSF) methodology based on Daniel's (1961) prior work on "success factors."

The CSF method is based on executives' individual preferences, implying that these factors can be different for different executives and that they can change over time for the same executive. For each organization, these CSFs are a limited number of areas which, if results are satisfactory, will ensure their competitive success. As such, executives have to pay special and continuous attention to these areas. This methodology proposes that CSFs have to be aligned with the organizations' objectives.

According to Rockart (1979), CSFs are designed according to:

a. The structure of each industry,
b. The companies' competitive advantage, market position and geographic location,
c. Environmental factors, and
d. Temporal factors.

CSFs can also be different among similar organizations given that the situation in one may still be quite different from that in another (Rockart, 1979).

In his article, Rockart (1979) declares that these CSFs do not serve to define the data needed to draft organizational strategy since the latter cannot be predefined. According to Rockart, then, the CSF method defines the information that executives need to monitor, manage, identify the places where information has to be monitored and improve existing business areas which can be easily defined. The same author would later declare, "recognizing that information is a strategic resource, this clearly implies the need to relate information systems to business strategy and, especially, ensure that the business strategy is developed within the context of new IT" (Rockart & Crescenzi, 1984). These authors allude to IT as much more than support for strategic planning. Rather, they propose that information technologies are strategy planning components in themselves (Rockart & Morton, 1984; Volonino & Watson, 1990). This idea is

key in furthering IT use by today's organizations and needs to be highlighted, though this is not a specific objective of this thesis.

Watson and Frolick (1993) propose that different methods can be used to determine EIS requirements. Volonino and Watson (1990) provide three alternatives when deciding which data need to be included in the first EIS version:

a. Present data which are critical to resolve a potential problem at that specific moment;
b. Key performance data; and
c. Information aimed at helping executives achieve their organizations' strategic objectives.

ii. EIS use

Various examples in the literature explore how executives use EIS systems: for planning and process monitoring (Rockart & Treacy, 1982) and for planning, analyses and activity monitoring (Volonino & Watson, 1990). Volonino and Watson declare in their article (1990): "EIS was developed to support Fisher-Price's strategic plan." According to Tang, information has to produce knowledge, and knowledge combined with a strategic management style can be effective. Without information, even strategically-oriented executives are operating only on the basis of good intentions (Tang, 1991). The output from analyzing data on the environment becomes an input in strategic decision-making. The quality of the data and the time required to process them are extremely important: when this information is processed manually, it can create distortions regarding various "information filters." As such, EIS systems should incorporate Artificial Intelligence elements to improve their procedures compared to traditional EIS, according to Wang and Turban (1991).

The Fisher-Price case (Watson, 2006) is a clear example of how executives need to be able to access information. In the mid-1980s, this toy manufacturer

and distributor suffered a dramatic drop in sales with the advent of videogames. The company was slow in discovering the change in trends due to the deficiencies of its information systems. As a result, it had to build new systems enabling it to access market data quickly and so be able to adequately respond to environmental changes. The company thus decided to develop an EIS system which would monitor its business processes and provide information to all those involved in decision-making. The company developed this EIS system specifically to help its executives make decisions, though, in this particular case, it was also developed for the rest of the company's employees: from lower echelons to salesmen.

iii. Methodology for EIS development

Volonino and Watson (1990) proposed a specific methodology to develop EIS projects: Strategic Business Objectives (SBO). The latter is based on EIS systems being designed to support organizational objectives as expressed by its executives. Crockett (1992) proposed an additional methodology to ensure that the needed strategic information flows into the EIS system:

a. Identify the critical success factors and the stakeholders' expectations;
b. Document the performance measures executives have to monitor;
c. Define report formats and frequency; and
d. Demonstrate how information actually flows and how to use it.

In highly dynamic markets, frequent changes in client requirements, product quality improvements, new cost controls, etc., are the norm. In these cases, EIS systems can help executives as these changes imply necessary transformations in organizational structures and in executive tasks (Volonino, Watson, & Robinson, 1995).

iv. Keys behind EIS success

Rainer and Watson (1995) analyze the keys behind the success of EIS systems both at the project development level as well as in their posterior use. These authors carry out a two-phase study: the first stage serves to determine what the key factors are, and the second to determine their importance. In the development phase, the authors argue that the 5 key factors in order of importance are: sponsorship by executives, support from senior management, defined requirements, the relationship between EIS systems and business objectives, and the quick delivery of the first EIS version. With respect to use, they propose the following 5 key factors: ease of use, precise data, on-time information, relevant data, and system reliability.

Prototyping is the most recommended EIS development methodology (Guimaraes & Saraph, 1991; Watson et al., 1991). It includes: problem definition, system development and system implementation. This methodology views user participation as a priority factor. In other words, executives have to participate in each attempt to refine the system, something which, without doubt, helps to align the EIS system and the executives. In addition, this methodology also allows new requirements to be incorporated as executives identify these in their changing environment.

There is an interesting reference about developing EIS systems using prototyping techniques (Nandhakumar & Avison, 1999). These authors analyzed an EIS development in a large manufacturing company (LMC), concluding:

> The development at LMC appeared to be characterized by improvisation, opportunism, interruption and mutual negotiation as much as progress milestones, planning and management control. The process was marked by cycles of interactions, rather than a sequence of pre-planned stages, in which the developers drew on their knowledge about organizational context and methodologies.

This example shows that sometimes organizations say that they are using a methodology when in fact they are not.

The literature suggests the existence of critical success factors (CSFs) for the development of information systems supporting senior executives (Poon &

Wagner, 2001). In their research, these authors found a dichotomy between success and failure cases in EIS implementations, speculating that the "meta-success" factors in an EIS system's successful implementation are: "championship," "availability of resources" and a "link to organization objectives." Furthermore, Salmeron and Herrero (2005) propose using the analytic hierarchy process (AHP) methodology to determine success factors priorities to successfully implement EIS systems.

v. Current EIS impact on executives' tasks

Though originally thought that information technologies would have an important impact on organizations, the actual impact on executives has been less than expected since they do not use ITs intensively in decision-making. According to Drucker (1998), this is due to the fact that ITs have not provided the information executives need but, rather, normally just internal data extracted primarily from accounting systems and without bearing in mind that external information is fundamental in decision-making. Normally, those working in the IT area generally argue that executives are not prepared to use ITs, but Drucker affirmed that IT developers have centered on the *technology* component, not *information*. According to Drucker, we need new models to overcome traditional accounting-based systems and to prepare information for executives. For example, he mentions activity-based costs and economic value added. The development of new methodologies, such as the Balanced Scorecard (Kaplan & Norton, 1992), Total Quality Management and Six Sigma, among others, provide executives with new models which can help them in strategic management processes.

Crockett (1992) agrees with Drucker, affirming that EIS' limits are as follows:

e. EIS systems still fail to provide the information executives consider crucial (or do so too late), even after their implementation.
f. The information they provide is not interrelated in terms of the different functional and strategic areas.

g. And, the information appearing does help to diagnose problems but it does not help find solutions.

vi. EIS failures

For many organizations, EIS projects are high-risk initiatives as they're aimed at users with few computer skills and who are skeptical in terms of how computers can help them improve their work (Watson, 1990). EIS projects are also seen as high-risk due to their high rate of failure (Houdeshel & Watson, 1987; Rockart & DeLong, 1988). The risk of failure may in fact be higher when implementing an EIS than key operational systems that have to be made to work regardless (McBride, 1997). Poon and Wagner (2001) argue that EIS implementation projects have failed, estimating that as many as 70% of these failures are due to technological, organizational, psychological and educational issues.

Expectations regarding EIS systems have not always been met (Anónimo, 1995). Chang and Zairi (Zairi, Oakland, & Chang, 1998) carried out a study identifying a list of motives behind EIS project failures based on the experience of 23 EIS developers and 15 executives. The first two motives refer to EIS design, while the last 3 to subjective system user factors:

a. A lack of definition and strategic focus,
b. Poor information quality,
c. Inadequate perception of its return,
d. Opposition from mid-level executives, and
e. Executives' educational background

Karten (1987) also indicated that EIS systems have not provided the expected value. She felt that executives need the right information at the right time, something which is difficult to achieve since this information is difficult to gather, consolidate and show. One of the primary motives behind this is that there are many incompatible information sources as they are not structured and cannot be anticipated. For these reasons, Karten argued that the true value computers

provide executives is their analytical speed and access to information. However, she did not consider the use of data warehouses which consolidate information from different sources. In addition, in cases where these incompatible sources exist, they can attempt to consolidate information through Extract, Transform and Load (ETL) tools or other, more sophisticated instruments which allow users to deduce content in empty data fields.

Arnott and Pervan (2005) analyze Decision Support Systems studies and conclude that a major omission in DSS scholarship is the poor identification of the clients (project buyers) and users of the various DSS applications that are the focus of research. They also refer to the problem of professional relevance or the practical contribution of DSS research.

In this thesis, I use Mind Manager (version 5.0.878) to develop the conceptual framework regarding EIS as can be seen in Annex 1. The map presented is small and not easily read or printed. I present it only as an example. I believe that this kind of software is really useful for state-of-the-art research. I also recommend researchers use mind maps to carry out literature reviews.

c. Technology Acceptance Model (TAM)

i. Introduction to the Technology Acceptance Model

Many scholars consider the Technology Acceptance Model (TAM) to be the most influential and widely-used theory in information systems (Lee et al., 2003). The object of this thesis is not to evaluate TAM and other theories on computer use. However, as TAM is one of the most tested theories, it should be included in the literature review with a view to listing the factors which might determine EIS use by senior executives. TAM has been tested and proven to be robust, though it has also been questioned.

Several authors originally proposed TAM in 1989 (F. D. Davis, 1989; F. D. Davis, Bagozzi, & Warshaw, 1989) with the aim of explaining a given

technology's adoption and use at the individual level. The cited authors' concerned themselves with user satisfaction and attitudes (F. D. Davis, 1989).

Researchers and professionals commonly use the Technology Acceptance Model (Burton-Jones & Hubona, 2006; F. D. Davis et al., 1989; F. D. Davis, 1989; Venkatesh & Davis, 1996; Venkatesh & Davis, 2000; Venkatesh, 2000) to predict and explain IT user acceptance. TAM (Figure 1) was originally designed to understand the causal relationship between external variables and the acceptance and real use of a given IT product.

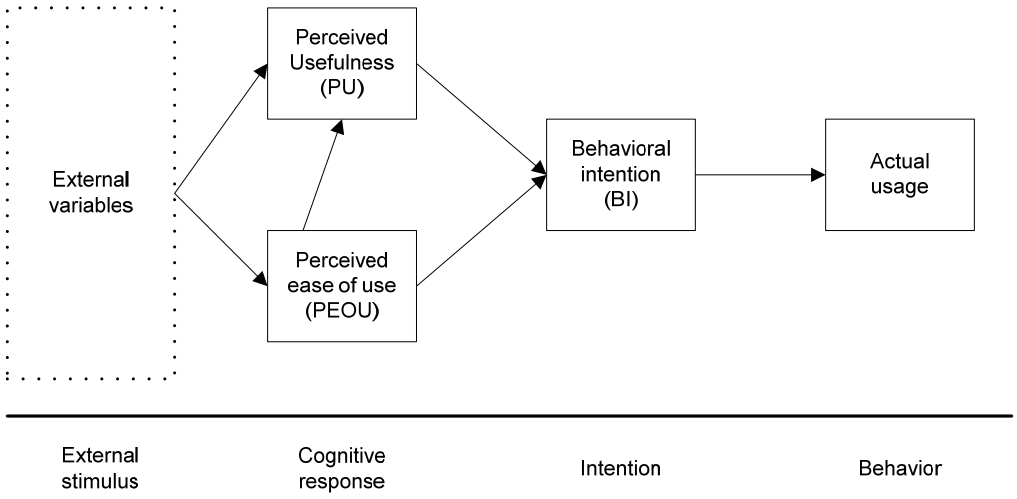


Figure 1: Technology Acceptance Model (TAM)

Research on TAM suggests that a user's behavioral intention (BI) is the factor which allows us to better predict how he or she actually uses the system. This intention is determined by the user's attitude towards the system's use. This attitude is in turn determined by the system's perceived usefulness (PU) and perceived ease of use (PEOU). Davis et al. (1989) defined perceived usefulness as "the degree to which a person believes that using a given system will improve their work results." Similarly, perceived ease of use refers to "the degree to which a person believes that using a given system will be effortless." The latter concluded their study with three main conclusions:

a. The use people make of their computers can be reasonably forecast based on their intentions.
b. Perceived usefulness is the most important determinant of people's behavioral intentions regarding their use of computers.
c. Perceived ease of use is the second most important determinant of people's intentions regarding their computer use.

After this seminal work, Davis et al. (1989) developed new scales regarding perceived usefulness and perceived ease of use. These new scales proved to be highly convergent, offering a discriminatory function and factual validity.

ii. TAM 2

Based on Davis et al.'s work, Venkatesh and Davis (2000) and Venkatesh (2000) extended the model, leading to TAM2. They also carried out two longitudinal studies demonstrating that "the pre-prototype's measurements regarding usefulness may well near the measurements found in the final solution and they significantly predict intention of use and behavioral intention six months after implementation" (Venkatesh, 2000).

TAM2 aims to establish a unified vision of users' IT acceptance (Venkatesh et al., 2003). As a result of this research, Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT), but it does not take into account the software application's characteristics or how the implementation project may affect perceived usefulness (PU) or perceived ease of use (PEOU).

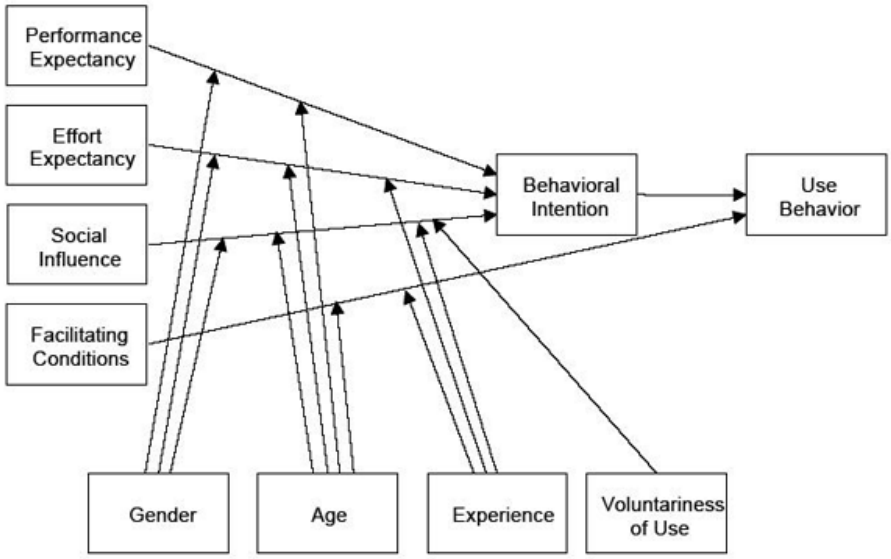


Figure 2: Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003)

The TAM method has also received important criticism, including from Benbasat and Barki (2007) regarding the great effort TAM requires and the number of TAM versions. Straub and Burton-Jones (2007) have also criticized the high risk of common methods variance when measuring perceptions.

iii. TAM and other lines of research

Other authors (Yi, Wu, & Tung, 2005) have used the TAM model to analyze how individual differences affect technology use. In their study, Yi, Wu and Tung conclude that individual differences can directly or indirectly affect the use of technology and may even moderate the relationship between perceptions and that use. Based on these discoveries, the authors propose a model which details the impact of individual differences on technology use.

Their model (Figure 3 below) proposes that individual differences can affect technology use in different ways. Firstly, individual differences affect technology usage (P1). Secondly, these differences affect technology use indirectly through perceptions (P3 and P4). And, finally, individual differences moderate the relation between perceptions and technology usage (P2).

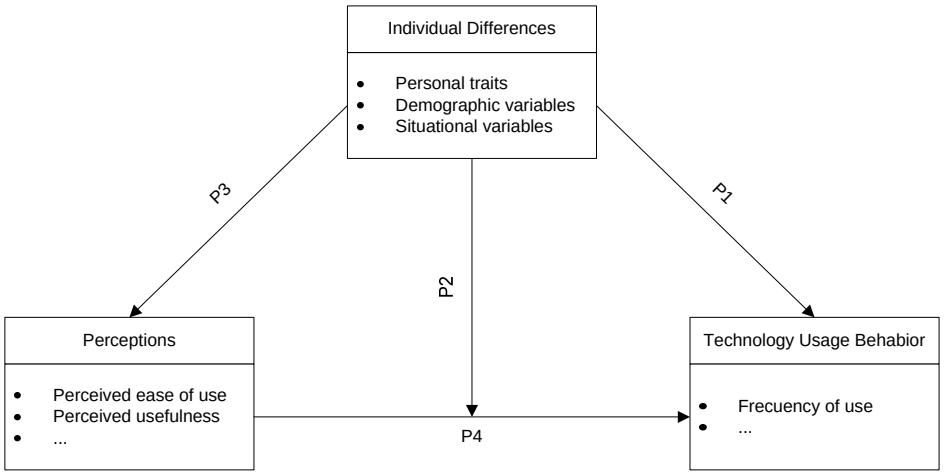


Figure 3: How individual differences influence technology usage (Yi et al., 2005)

iv. External variables or factors

The terms “external variables” and “external factors” are used indistinctly by different authors in TAM research (F. D. Davis, 1989). According to Davis and Venkatesh (1996) these factors are: “objective design characteristics, training, efficient use of computers, user involvement in design and the nature of the implementation process.” According to Davis et al. (1989), they encompass “the technical traits of the system design, user involvement in system development, the type of development process for the system used, the cognitive style, training documentation, consultant support for users, system functionalities, user traits, and end behavior.” A later study reviewing existing articles signaled that “there was no clear pattern with respect to the choice of external variables considered” (Legris, Ingham, & Collerette, 2003). These same authors also refer to the 39 factors affecting satisfaction levels with an information system as described by Bailey and Pearson (1983) and to Cheney, Mann and Amoroso’s (1986) classification of the different factors.

In their study, Pijpers, Bemelmans, Heemstra and van Montfort (2001) selected external variables based on Venkatesh and Davis’ (1996) discussion on “other

researchers and other areas of research." They grouped these variables by: individual traits, organizational traits, task traits and IT resource traits. However, their research suggests that few of the above variables directly or indirectly influence actual use.

Lee et al. (2003) published a complete meta-analysis of publications on TAM. They proposed a chronological analysis of TAM's evolution over time and researchers' contributions to TAM in terms of: the systems types to which they apply the TAM model, the external variables or factors, major limitations, number of publications by years and journals, the most prolific authors, research objective traits, and research methodologies. Lee et al. conclude their article recommending that various areas require further analysis. This includes incorporating more variables and exploring environmental conditions. These authors also declare that we need more in-depth knowledge about the factors affecting perceived usefulness (PU) and perceived ease of use (PEOU) and that we need to examine different information systems in different settings, more complex information systems, and the effects in different settings and with more complex tasks. They also insist that more qualitative research is needed on a smaller number of individuals to reveal more valuable information.

As discussed above in the section on motivations behind this thesis, I have attempted to uncover these factors from qualitative interviews and from the literature review. I then asked the surveyed senior executives to group and rate the factors in keeping with Lee et al.'s (2003) recommendations to find out more about the factors and because two similar studies can have different approaches and different results as discussed.

My first research question is:

Is additional qualitative research needed to find more valuable information about the factors?

v. Critical reflections on TAM

Organizations spend a lot of money on new information systems. Their expectations are that these new systems will be adopted by internal users, but sometimes they don't as expected.

Technology acceptance has been an enduring question in IT research (Hirschheim, 2007), and "TAM has had a significant influence on the IS field" (Venkatesh, Davis, & Morris, 2007).

As Lucas, Burton Swanson and Zmud (2007) indicate: "Essentially, TAM reduced predictors of an individual's intention to adopt a new IT innovation to a core set of two variables, perceived usefulness and perceived ease of use," adding, "the model provides relatively few implications for management for implementing new technology." In my opinion, this is what lacks the most. To manage implementations we need to know what the antecedents are in order to manage them during and after the implementation process.

Numerous explanations in the literature attempt to justify why users don't adopt new systems. For example, Goodhue (2007) asked rhetorically: "How often are information systems a poor fit for the tasks to which they are applied?" He answered: "Sadly, the answer is too often," proposing researchers add "perceived fit to the task" to TAM. He also criticized TAM, saying: "TAM makes an implicit assumption 'that more use is better.'"

Benbasat and Barki (2007) criticized TAM because they agreed with Hirschheim (2007) who said that "the field's focus on TAM-based explanations has either directly or indirectly diverted researchers' attention away from many other more important research issues associated with IT adoption, and this has led to a state of theoretical chaos and confusion." This is because there are various TAM versions to which authors have added social influences, facilitating conditions, etcetera. Benbasat and Barki (2007) also use some examples from the literature to argue that "researchers have sought to add constructs to TAM

as these became relevant to the changing technology, leading to the present situation." In other words, they argue that researchers have to take into account the IT artifact itself, the IT artifact users, and also the context where they are using that IT artifact. They also add, "Moreover, another reason for adhering to the global and generalized perceptions measured in TAM, which has resulted in our lack of understanding of its antecedents, is that opening a black box of usefulness is neither straightforward nor trivial." They proposed instead that "it would be fruitful to investigate the antecedents of usefulness in order to provide design-oriented advice." I also believe that TAM can be like a "black box" if we can measure the perceived usefulness and perceived ease of use. However, we don't know what the antecedents are nor, as such, what value TAM provides.

These criticisms have encouraged me to include TAM in this research. Although TAM is a central piece in adoption research, I decided to increase the scope by including factors from other research areas in an attempt to broaden our perspective. These additional factors come from a literature review based on the factors that senior executives might take into account with software applications and computers, and factors that senior executives think might affect their use of EIS as mentioned in interviews.

In this study I decided not to explore the relationships between factors and "perceived usefulness" and "perceived ease of use" because doing so would have increased the complexity of the survey even further. In addition, the scope of this thesis goes well beyond TAM.

Below I present my own approach using Concept Mapping.

4. Methodology

a. Introduction to Concept Mapping

For this research I use the Concept Mapping model proposed by Trochim and Linton (1986). As Trochim (1989b) defined:

- Concept Mapping is a general framework for structured conceptualization and it shows how specific conceptualization processes can be devised to assist groups in the theory and concept formation stages of planning and evaluation.
- This process can be used whenever there is a group of people who wish to develop a conceptual framework to evaluate or plan, displaying the framework in the form of a concept map.
- A facilitator guides the Concept Mapping process. He or she can be an outside consultant or an internal member of the group responsible for planning or carrying out evaluation efforts.
- The facilitator's role is only to manage the process. The concept map's content, interpretation and utilization are determined entirely by the group.

This process usually consists of 6 steps (W. M. K. Trochim, 1989b) as detailed in Figure 4 below.

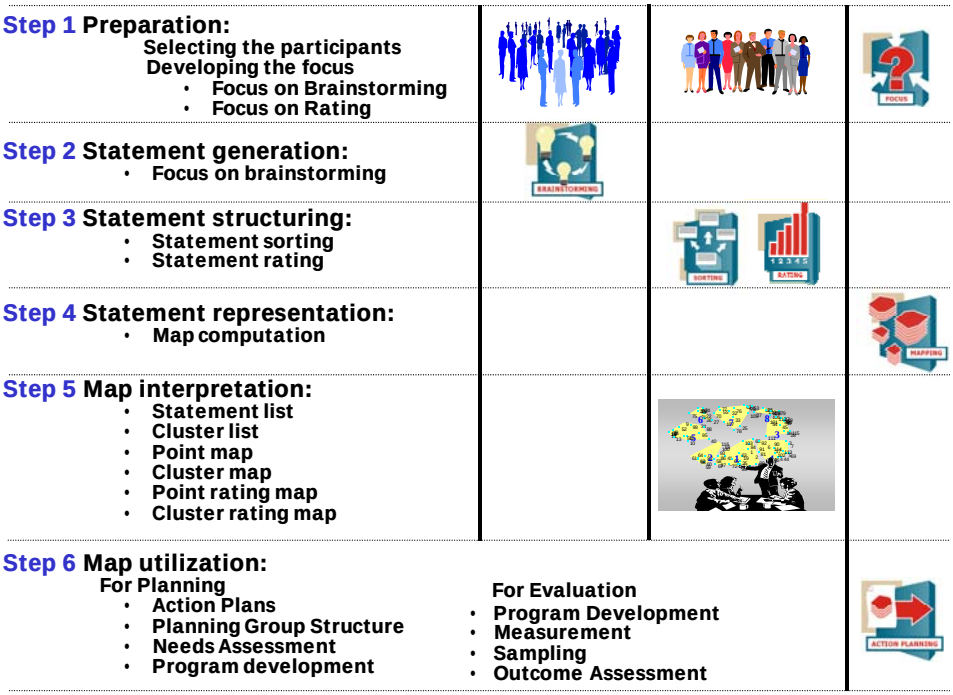


Figure 4. Concept Mapping steps (W. M. K. Trochim, 1989b)

Scholars have applied Concept Mapping in a large number of studies with subjects ranging from education and educational administration to children and youth, mental health, the elderly, health, and the arts. Some specific examples include developing family support programs (Rosas, 2005), organizational learning (Sutherland & Katz, 2005), developing healthcare programs (Burke et al., 2005; U. Nabitz, Van den Brink, & Jansen, 2005; W. M. Trochim, Cabrera, Milstein, Gallagher, & Leischow, 2006; W. M. K. Trochim, Milstein, Wood, Jackson, & Pressler, 2004; W. Trochim & Kane, June 2005; Yampolskaya, Nesman, Hernandez, & Koch, 2004), smart card technology adoption (Martin & Rice, 2010), improving the EFQM model (U. Nabitz, Severens, Brink, & Jansen, 2001), and determining which factors may influence and shape client loyalty towards travel agencies (Bigné, Aldas-Manzano, Kuster, & Vila, 2002). Other applications have also attempted to contribute to other methodologies' analysis of open-ended survey responses (K. M. Jackson & Trochim, 2002; Rosas & Camphausen, 2007) or scale development and validation in evaluations (Rosas & Camphausen, 2007). These projects have also had different purposes: planning, evaluation, survey design, curriculum development, theory building and management (W. M. K. Trochim, 1989a).

There are different types of participants in these studies, from graduate students to agency representatives, staff and board members. Important differences also exist in terms of the number of people participating, from 4 to 75, and also in the number of statements, from 11 to 137, as presented in Trochim (1989a).

Some references to understand the reliability and validity of Concept Mapping can be found in Trochim (1993) and in Jackson and Trochim's work (2002). I refer to both studies further below.

Other qualitative methodologies such as focus groups or brainstorming could be applied, but, according to Nabits et al. (2001), Concept Mapping "takes the best of two worlds and combines the inductive aspects of the forum approach and the deductive aspects of statistical procedures." These authors also applied Concept Mapping to their research on managers as I do.

I adapted the first two steps in the Concept Mapping methodology due to the difficulty in accessing senior executives and also because senior managers are reluctant to spend a lot of time on one single activity. This is not the first time that someone adapts this methodology. Actually, Witkin and Trochim (1997) did so in one study. Participants were faculty members, and the authors' objective was to synthesize listening constructs. Bigné et al. (2002) review the literature and interview experts later. Nabitz et al. (2001) use the European Foundation for Quality Management (EFQM) as the starting point of their study. These changes are reflected in Figure 5.

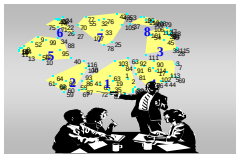
Step 1 Preparation: • Developing the focus • Experts Interview • Literature Review	 Literature review and preliminary interviews
Step 2 Statement generation:	
Step 3 Statement structuring: • Participant selection • Statement sorting • Statement rating	
Step 4 Statement representation: • Map computation	
Step 5 Map interpretation: • Statement List • Cluster List • Point Map • Cluster Map • Point Rating Map • Cluster Rating Map	

Figure 5. Concept Mapping steps adaptation
(Source: the author)

I use Concept Mapping to answer my second and third research questions.

The second research question in this thesis is:

What groups of factors do senior executives believe affect their use of executive information systems?

And, the third research question is:

How important are these groups of factors for senior executives?

As discussed in the previous section, Concept Mapping consists of different steps. I discuss each of these steps in detail:

b. Step 1: Preparation

This step is divided into three sub-steps:

i. Developing the focus

The focus of this thesis is to identify and rate the group of factors that can affect how senior executives use executive information systems.

ii. Expert user interviews

We carried out two interviews with two executives and presented a paper at a doctoral consortium that was later published (Cano, Fernández Alarcon, & Díaz Boladeras, 2008). This paper is presented as Annex 2. The output of these first interviews were 15 factors or variables. The list is included in Table 1 below.

Factors related with "the perceived ease of use of an EIS":
Easy to know what information the EIS contains
Easy to know the model underlying the information
EIS provides the information one is interested in.
Easy drill-down from aggregated information to detailed information
Help should be simple, short and clear (I found a preference for initial training).
The same 'functionalities' as 'Windows' or the Web browsers
Easy to learn
Easy to remember
Easy to interpret the information: graphics, tables, etc.
Factors related with "the perceived usefulness of EIS"
The first screen must contain the most important information above the key areas.
If there is a problem, users can focus on it, disregarding the details.
A "map-like function" when users get lost
Know how the calculation is done (having the option of checking formulas)
Multidimensionality
Spend as little time as possible to find the information that users need

Table 1: Factors related to "the perceived ease of use and perceived usefulness of an EIS" from senior executive interviews

We discovered 15 factors through these interviews, but executives made no reference to the other factors usually found in the literature relative to organization, executive skills or capabilities, trust, etcetera. As such, I had to widen the scope of analysis to compare the factors that senior executives mentioned during the interviews and compare them with other factors in the literature. This has allowed me to respond to the first research question.

iii. Literature review

There are three inputs in the literature review: the first is the list of the factors in Yousafzai, Foxall and Pallister's (2007a) TAM meta-analysis; the second is a review of factors in TAM; and the third is an open approach which stems from a literature review about the relationship between executives and computers and software applications. My primary objective with this last literature review was to broaden the scope on TAM and add the senior executives' perspectives as mentioned in the previous section. I present my main findings here:

- Yousafzai, Foxall and Pallister's (2007a) TAM meta-analysis includes 79 external variables grouped by: organizational characteristics, system characteristics, users' personal characteristics, and other variables. The entire list and details of the variables can be found on page 269 of their paper.

- I carried out a review of external variables and antecedents in TAM. I found 111 papers related with TAM or with external variables. I selected 31 papers based on their discussion of these factors (Adams, Nelson, & Todd, 1992; Agarwal & Prasad, 1998a; Burton-Jones & Hubona, 2006; F. D. Davis et al., 1989; F. D. Davis, 1989; F. D. Davis & Venkatesh, 1996; F. D. Davis & Venkatesh, 2004; S. Davis & Wiedenbeck, 2001; Gefen & Straub, 1997; Gefen & Straub, 1997; Gefen, Karahanna, & Straub, 2003a; Gefen, Karahanna, & Straub, 2003b; Igbaria, Guimaraes, & Davis, 1995; Igbaria, Zinatelli, Cragg, & Cavaye, 1997; C. M. Jackson, Chow, & Leitch, 1997; Legris et al., 2003; D. Straub, Keil, & Brenner, 1997; Szajna, 1996; Venkatesh, 2000). I found 216 external variables mentioned in said papers. As can be seen in Table 2 below,

in some cases there are several variables in the same cell. For example, I divided the factor “more accurate forecast or higher quality graphs” (F. D. Davis, 1989) into two. As such, the number of rows in the table is 185 less than the 216 factors originally found.

Authors	Factors
Davis (1989)	The system's technical design characteristics
	User involvement in system development
	The type of system development process used
	The nature of implementation process
	Cognitive style
	System design characteristics
	User characteristics (cognitive stile and other personality variables)
	Task characteristics
	Nature of the development of implementation process
	Political influences
	Organizational structure
	Menus, icons, mice, and touch screens
	Training, documentation and user support consultants
	More accurate "forecast" or higher quality "graphs"
	Learning based on feedback
	System features
	User characteristics
	Ultimate behavior
	User interface
	Better training
	Accuracy or amount of information accessible through a system
Davis et al. (1989)	Objective system design characteristics
	Training
	Computer self-efficacy
	User involvement in design
	Nature of the implementation process
Legris et al. (2003)	Situational involvement, intrinsic involvement, prior use, argument of change
	Internal computing support, internal computing training, management support, external computing, support, external

	computing training
	Perceived developer responsiveness
	Role with regard to technology, tenure in workforce, level of education, prior similar experiences, participation in training
	Quality perceived subjectiveness
	Compatibility, trainability, visibility, result demonstrability
	Tool functionality, tool experience, task technology fit, task characteristics
	Subjective norms, voluntariness, image, job relevance, output quality, result demonstrability
	Gender, experience
	Effect of experience
	Implementation gap, transitional support
	Output quality
	Computer self-efficacy, objective usability, direct experience
	No external variable
Jackson et al. (1997)	User involvement
	Designers to create a favorable user attitude by involving users in system development work
	Mediating role of attitude
	Learning and affective-cognitive consistency 364
	The easier a system is to use, the greater the belief that the system will support informational needs.
	Situation involvement and user's "perceived influence"
	Increased situation involvement may actually result in conflict and lead to a reduction in perceived usefulness.
	Individuals who have participated in the system development process are apt to develop beliefs that the system is both important and personally relevant.
	Components of intrinsic involvement
	People develop competence because they learn from experience how to focus quickly on important facets of a problem in a particular domain.
	The features of a computer system impact perceptions about the system.
	A person's beliefs or perceptions can be influenced by what he or she believes.
	The argument for change must contain well-supported explicit facts to influence one's beliefs about the perceived usefulness of

	the system.
Davis and Venkatesh (2004)	System design characteristics
	Training
Adams et al. (1992)	User experience
	Type or sophistication of system use
	Other task
	User characteristics
Szajna (1996)	The task
	User characteristics
	Political influences
	Organizational factors
	Development process
Venkatesh (2000)	Control (internal and external - conceptualized as computer self-efficacy and facilitating conditions, respectively)
	Intrinsic motivation (conceptualized as computer playfulness)
	Emotion (conceptualized as computer anxiety)
Igbaria et al. (1997)	Internal computing support
	Internal computing training
	Management support
	External computing support
	External computing training
Burton-Jones and Hubona (2006)	System experience
	Level of education
	Age
	Task characteristics
	Perceived behavioral control
Straub et al. (1997) and Straub and Burton-Jones (2007)(2007)	Power-distance
	Uncertainty avoidance
	Masculinity
	Individualism
Agarwal and Prasad (1998a)	Personal innovativeness
	Communication channels
	Mass media
	Interpersonal communication
Igbaria et al. (1995)	Individual characteristics and computer experience
	Organizational support
	System quality
	Beliefs
Davis and Wiedenbeck	Computer interaction style

(2001)	Prior exposure
Gefen, Karahanna and Straub (2003b)	Situational normality
	Familiarity with the e-vendor
	Social influences
	Characteristics of the system and of the task
Gefen and Straub (1997)	Perceived social presence and richness of the medium (SPIR)
	Gender
Igbaria (1993)	User training
	Computer experience
	Information center support
	Management support
Venkatesh and Davis (2000)	Subjective norm
	Image
	Job relevance
	Output quality
	Result demonstrability
	Experience
	Voluntariness
Igbaria and Tan (1997)	Precise information you need
	Content meets your needs
	Reports
	Sufficient information
	Accurate
	Satisfaction with the accuracy
	Useful output format
	Clear information
	User friendly
	Easy to use
	Timely
	Up-to-date information
Venkatesh et al. (2003)	Performance expectancy
	Effort expectancy
	Social influence
	Facilitating conditions
	Experience
	Voluntariness of use
Yi et al. (2005)	Personal innovativeness
	Computer experience
	Encouragement by others

Compeau and Higgins (1995)	Others' use
	Support
	Computer self-efficacy
	Outcome expectations
	Affect
	Anxiety
Karahanna, Straub and Chervany (1999)	Image
	Compatibility
	Visibility
	Result demonstrability
	Trialability
	Top managers
	Peers
Roberts and Henderson (2000)	Computer anxiety
	Perceived fun
Agarwal and Prasad (1998b)	Relative advantage
	Compatibility
	Personal innovativeness
Hong, Thong, Wong and Tam (2001)	Computer self-efficacy
	Knowledge of search domain
	Relevance
	Terminology
	Screen design
Gefen and Keil (1998)	Perceived developer responsiveness
Karahanna and Straub (1999)	Social presence
	Social influence
	Physical accessibility
	Support
Igbaria and Iivari (1995)	Computer experience
	Organizational support
	Self-efficacy
	Computer anxiety
Pijpers, Bemelmans, Heemstra and van Montfort (2001)	Computer experience
	Computer training
	Cognitive style
	Computer anxiety
	Computer self-efficacy
	Individual culture
	User involvement

	Perceived fun/enjoyment
	Organizational structure
	IT maturity
	Organizational support
	Organizational culture
	Organizational usage
	Social pressure
	Environmental uncertainty
	Competitor behavior
	Task related
	Accessibility
	Implementation process
	User interface

Table 2: Factors related to "the perceived ease of use and perceived usefulness of an EIS" based on a review of literature dedicated to TAM

Some may ask why I didn't include Davis' (1989) 12 questions to determine perceived usefulness (PU) and perceived ease of use (PEOU). The reason is that my main objective here is to determine the factors, while Davis's aim with those questions was to measure perceptions: PU and PEOU. As such, these questions are not valid to define the factors or understand how they affect senior executives' use of EIS systems.

- The last input comes from a literature review included in the paper, "Use of computers and applications by senior executives" (Cano Giner, 2011), included in this thesis as Annex 3. Said review includes 37 additional external variables (see Table 3 below).

As mentioned, several studies in the literature analyze how executives use computers and applications. One of the first of these was conducted by Brady (1967), addressing the issue of whether computers had changed the method, form or content of executives' decision-making. Brady concluded his study stating that computers had had no impact on how executives made decisions. In the same study, he also indicated that executives were not using computers due to:

- A lack of understanding (or training) on how computers can be used for decision-making by executives,
- A defensive attitude on the part of some executives regarding the threat posed by computers to their decision-making functions and their prerogatives to exert their "opinion,"
- A lack of applications developed and specifically intended for decision–making,
- Indecision on the part of executives in formally identifying the decision-making criteria they wanted to use, and
- Executives' tendency to wait for other firms to invest and take the initial risk of pioneering the use of new computer applications.

Brady (1967) forecast that significant advances in the impact of computers would be achieved simply as a consequence of the passage of time and staff turnover. However, he recommended speeding up changes by developing and training both middle and senior executives. In his study's conclusions he predicted that by the mid-1970s computers would cause changes in a large number of aspects related to executive decision-making.

Another of the key papers dealing with computer use by executives is "The CEO goes on-line" by Rockart and Treacy (1982). In this article, the authors showed how CEOs increasingly access and use information from computers on a regular basis. They described how four senior executives use computers, specifically with EIS applications. These offer executives analytical tools in their search for greater insight into their companies and sectors, the possibility of personalizing them to meet each executive's information needs, and the possibility of implementing them by starting with small projects that can grow gradually. EIS systems are intended to help executives use information more effectively. The authors conclude their paper with the following statement:

> Not all senior managers, of course, will find an EIS system to their taste, but enough user-friendly technology now exists to accommodate the needs of those who wish to master a more data-intensive approach to their jobs.

PC use by executives was subsequently analyzed by Mawhinney and Lederer (1990) who employed a model consisting of four groups of variables: managers' attributes in the organization (level, span of control, type of work, control of the system, and contribution to job performance), personal attributes (age, sex, level of training, typing skills, and competence in using the system), system attributes (ease of learning, ease of use, accessibility, response time, and suitability), and process attributes (participation in the acquisition, satisfaction with the system, training in its use, and technical support). The authors analyzed how these variables affect PC use by the executives, discovering that none of the groups of variables seem to dominate the model and that the two items with the strongest correlation with reported time of use time were: 1) the system's contribution to job performance and 2) the managers' level of competence with the system.

Managers are reluctant to spend extra time learning other applications when they can do what they want on a spreadsheet, even if this is not the most efficient way of doing it, according to Seeley and Targett (1997 and 1999) . They reported on several studies which analyze senior executives as computer users. In their paper's conclusions they stated that senior executives use computers more extensively than before, that they use a larger number of applications more competently than they used to, and that the number of applications they use can be related to age (younger executives use a wider range of applications).

Drucker (1998) explores the meaning and purpose of information in an article entitled "The next information revolution." The author states that senior executives do not use new technologies because these technologies don't provide them with the information they need for their work; likewise, he argues that the accounting systems at their disposal do not help them in decision-making. Another aspect Drucker highlights is that senior executives have a degenerative tendency, especially in big corporations, to focus inwards (on costs and results) rather than outwards (on opportunities, changes and threats). Consequently, he predicted a trend over the following 10 to 15 years towards gathering external information. One of the factors that can cause a change in

this trend is better training in technologies that he forecasts senior executives will have in the future. Another issue Drucker addresses is whether system employees and directors are prepared to tend to the senior executives using the medium required to learn about ITs.

In their study on senior executives' personal use of computers, Seeley and Targett (1999) conclude that this use is related to the dynamic and complex iteration between both internal factors, such as executives' perception of their role as managers, *modus operandi* and personality, and certain factors, such as system infrastructures, the nature of the task and organizational culture.

Poon and Wagner (2001) revise the Critical Success Factors model (Rockart & DeLong, 1988) to apply it to information systems for executives, confirming the applicability of Rockart and DeLong's eight original factors while adding two additional ones. Nevertheless, Poon and Wagner consider that, out of all the success factors, success is possible if we manage just three of them: support at both executive and operational levels; resources; and linking the system to the business objectives.

According to Pijpers et al. (2001), the perception of fun/enjoyment that senior executives may have when using an information system is an external variable that influences their beliefs about, attitude towards and use of information systems.

Xu and Kaye (2002) analyze the support executives need, concluding that they require support from information specialists rather than technology specialists. The function of the former is to scan external information in the outside world, turn it into meaningful information and make it easily accessible to managers so that they can use it. Consequently, when EIS systems are designed and implemented, we have to train the executives not only on how to use the system but also about the information they will find there, information which is systematically updated, analyzed and formatted by information specialists before the executives actually use the system. These specialists must therefore be familiar with executive culture; they must exploit and obtain executives'

vision and knowledge to judge and interpret the information and make explicit that which must be shared among information specialists.

We also have to take into account the differences between expert and novice executive computer users, as shown by Hung (2003). Executives' skills affect system use; expert users require less time to reach a solution and view more screens when performing analytical tasks, whereas novices view more screens when performing more intuitive chores, and executives feel more useful when they use more powerful systems. Furthermore, expert users consider intuitive systems to be more useful than analytical ones, whereas the difference is not significant for novices.

Senior executives are not benefiting from the use of technologies according to Seyal and Pijpers (2004). A lack of commitment to IT use and their applications can be seen as a threat to competitiveness. According to the authors, several reasons account for impediments to IT use: 1) senior executives have little time to experiment with new technologies; 2) they are reluctant to use the technology due to PC anxiety; and 3) senior executives lack skills and proficiency in IT use and, moreover, require support staff to answer their queries. Some senior executives argue that they see no connection between what ITs do and their tasks as senior executives. The latter's reaction to ITs is even worse if they did not take any IT-related course during their college years.

Internationalization has also created the need to assess whether senior executives make strategic decisions differently depending on their origin. Martinsons and Davison (2007) analyze the differences among American, Japanese and Chinese executives, defining different decision-making styles among these; hence, information technologies must be adapted to the different styles of their users.

I ascribed the 37 reasons cited by various authors and studies above to one of the following categories in Table 3: Senior Executives, System, Project, or Others. Subsequently, with the object of reducing the number of factors, I grouped them whenever possible, taking into account those that are similar and

had been cited in more than one of the studies involved. In the event of the factors being insufficiently alike, I put them in different groups. Table 3 shows all the groups and each factor allocated within the new classification, including all the contributions from the various studies. For example, the factors grouped together under the "Project" heading and in the "resource availability" section are: lack of support staff to answer executives' queries, support from information specialists, system chiefs capable of tending to executives' demands, available resources, and system infrastructures. Each of these factors is clearly related to the availability of both economic and personal resources in a given project. However, the factors grouped together under "resource availability" are not related to other project groups, i.e., they are not related to: "support from management," "incremental project" or "alignment" categories. In my analysis I have taken into account each factor and its possible relationship with the rest. I kept those that were not related to any others apart to form a group of their own. This is the case, for example, with executives' tendency to wait for other firms to invest and take the risk of being the first; this factor is not related to any of the other 36 (Cano Giner, 2011).

Relationship	Groups of factors	Factors
Senior Executives	IT training	• Lack of understanding of computer use • Stronger training in computer use • Reluctance to spend extra time learning applications other than spreadsheets • Stronger IT training for executives • Little time to play around with new technologies
	Competence in using the system	• Level of competence with the system • Lack of skill and dexterity in IT use
	Age	• Older executives use a narrower range of applications
	Personality	• Personality
	Modus operandi	• Modus operandi
	Attitude to ITs	• Reluctance to use the technology due to PC anxiety • Perception of fun or enjoyment in IT use • A defensive attitude • Executives' perception of their roles as managers
	Ability to identify decision-making criteria	• Indecision on the part of executives in formally identifying the decision-making criteria they want to use
	IT contribution	• Nature of the task • No connection seen between what ITs do and their task as executives • Contribution to job performance

	Risk aversion against investing in ITs	• Executives' tendency to wait for other firms to invest and take the risk of being pioneers
System	Functionality of the system	• Personalization of applications • Adapt to the different styles of their users • Need to adapt systems to executives' experience • Lack of applications development
	Specificity of the system	• Availability of applications designed for executives' tasks
Project	Support from management	• Support at both executive and operational levels
	Resource availability	• Lack of support staff to answer executives' queries • Support from information specialists • System chiefs capable of tending to executives' demands • Available resources • System infrastructures
	Incremental project	• Incremental project
	Alignment	• Linking the system to the business objectives • System does not provide executives with the necessary information • Need for systems to collect more external information
Others	Other factors	• Passing of time • Organizational culture • Management changes due to staff movements

Table 3: Factors related to "the relationship between executives and computers or applications" based on a literature review

All the factors relate to different kinds of information systems, including: word processors, electronic mail, voice mail, spreadsheets, personal computers, internet browsers, software packages, decision support systems, executive information systems, web portals, e-commerce stores, etcetera.

c. Step 2: Statement generation

The objective of this step is to generate short conditional phrases or statements which describe the factors that could increase executive information system use by senior executives.

I began with a long list of variables, concretely, 347 factors stemming from four different sources: the interviews, TAM meta-analysis, the literature review of TAM and external variables and a literature review on the relationship between executives and computers or applications.

I selected the variables in two phases due to the number of factors to be managed:

i. First phase

I assigned a number to every variable to be able to track them. I then attributed a general label to every external variable to help find similar or duplicate variables, and then ordered the statements by these labels. The labels include, for example: system, user, project, information, task, etcetera. These labels helped me group sentences and compare them to find duplicities and similarities.

I accepted fifteen of the variables stemming from executives' interviews to see if senior executives felt that these factors were more relevant than the factors from the literature review.

Some duplicity existed between variables (188). Also, some variables didn't seem to have any relation with executive information systems and executives (10); and there were 30 external variables that were "too general" and were therefore discarded.

After this first classification, there were 119 statements left, but no more than 100 are recommended (W. M. K. Trochim, 1989b). As such, I had to reduce the list by at least 19 more. I did this in the second phase.

ii. Second phase

The criterion I used to discard external variables was to exclude those that EIS developers can't control for; this includes, for example, the user's age and level of education. I thus discarded 25 factors, leaving 94 for executives to sort and rate.

Once I selected these external variables, I then used the RANDOM function in Excel to order the statements in an indiscriminate manner and assign them a number between 1 and 94.

Finally, I selected 94 external variables to be grouped. Table 4 below describes the variables' origins.

	Accepted	Discarded in second phase	Duplicities	No relation	Too general	Total	Accepted	Number of papers
Output from the first interviews	15	0	0	0	0	15	100%	1
External variables in TAM meta-analysis	38	11	21	3	6	79	52%	1
Review of TAM antecedents and determinants	21	11	156	5	23	216	12%	34
Output from the literature review in the paper "Use of computers and applications by senior executives"	20	3	11	2	1	37	54%	12
Total	94	25	188	10	30	347	29%	48

Table 4: Summary of the external variables

I provide a schema in Figure 6 to summarize Step 2.

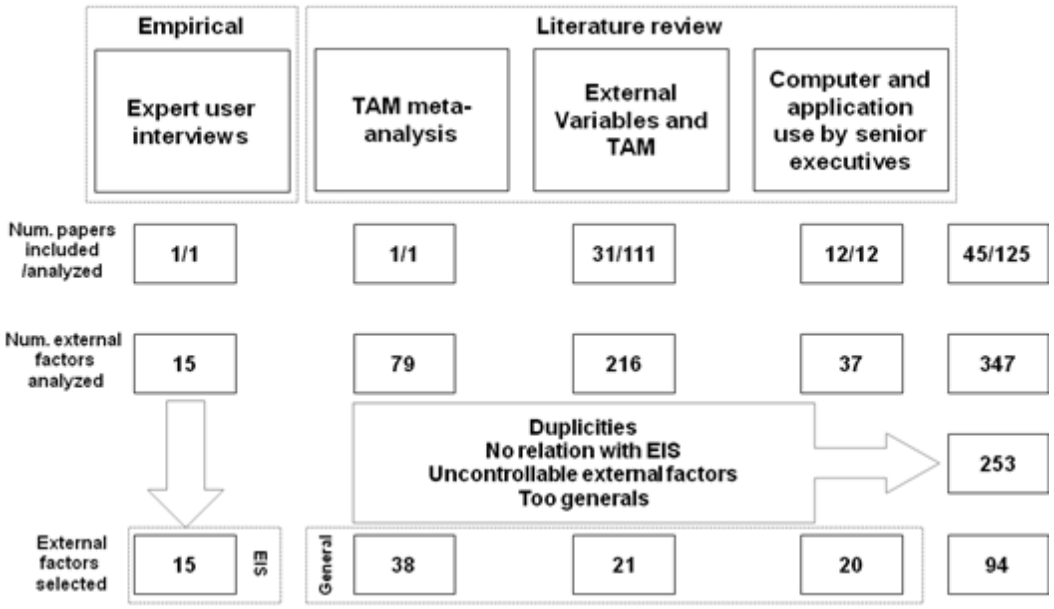


Figure 6: Schema of the process to find factors

I also changed some terms such as “user” and “users” for “executive(s)” and “system” and “systems” for “Executive Information System(s).” I also rewrote the sentences to facilitate executives’ understanding.

In those cases where there was duplicity between factors, I did not have a preference in terms of selecting variables from different origins with the exception of those stemming from the interviews. For my analysis, this implies that there is one general group of factors that originates from three different sources: TAM meta-analysis, a review of external variables in TAM and a review of computer and application use by senior executives. This was required to be able to compare ratings from senior executives. For my posterior analysis, I called this group of factors “General,” while I called the group of factors coming from interviews “EIS”, as depicted in Table 5 below.

As a result, 15 factors stem from Executive Information System interviews (the “EIS” label in the “Factor origins” column in Table 5) and 79 factors from other Information Systems as described in the literature (the “General” label in the “Factor origins” column in Table 5).

Factor number	Factor	Factor origins
1	If other executives had influenced you to use the executive information system …	General
2	If the executive information system had been easier to remember…	EIS
3	If the executive information system screens had been designed better …	General
4	If the quality of the executive information system information had been better …	General
5	If the executive group had been more innovative …	General
6	If the use of the executive information system had been a part of the organization's culture ...	General
7	If the executive information system had been easier to learn …	EIS
8	If the executive information system had included an information confirmation mechanism …	General
9	If you had been closer to sources of power …	General
10	If there had been a problem and you could have used the executive information system to focus on the issue, disregarding the details, …	EIS
11	If the executive information system could have been adapted to the different executive leadership styles …	General
12	If you had suffered from job insecurity ...	General
13	If the executive information system had included the information you needed …	EIS
14	If the executive information system had been more reliable …	General
15	If the executive information system had offered a greater wealth of information …	General
16	If the executive information system had included more external information ...	General
17	If you had been less defensive …	General
18	If someone had demonstrated the positive results obtained from using the executive information system …	General
19	If there had been organizational pressure to use the executive information system …	General
20	If the project had had more visibility …	General
21	If you had needed less time to find the information required …	EIS
22	If the executive information system and the business objectives had been better linked …	General
23	If the project's implementation process had been better…	General
24	If the project's implementation had been incremental …	General
25	If you had felt greater cultural affinity with the executive information system ...	General
26	If you had been more predisposed to using computers …	General
27	If the executive information system had had a drill-down function, enabling you to go from aggregated information to detailed data, …	EIS
28	If you had had support from information specialists …	General
29	If there had been institutional control over the executive information system's use ...	General
30	If the system's infrastructures had been better …	General
31	If the executive information system had been multidimensional in terms of functionality …	EIS
32	If it had been easy to interpret the information in the executive information system’s graphs, tables, reports, etc. …	EIS
33	If the executive information system had had the same functionalities as Windows or the Internet …	EIS
34	If your ability to concentrate had been better …	General
35	If you had trusted the executive information system …	General
36	If resources had been available for the executive information system …	General
37	If you had perceived that the executive information system was less complex …	General
38	If it had been easier to know what information the executive information system contained …	EIS
39	If you had been better at using the executive information system …	General

40	If the designers had instilled a more favorable attitude among executives by involving them during the implementation project …	General
41	If it had been less difficult to use the executive information system …	General
42	If the organization had used the executive information system more …	General
43	If you had had more experience with the executive information system …	General
44	If you hadn't been reluctant to spend extra time learning how to use applications other than spreadsheets …	General
45	If you had been more computer literate …	General
46	If the executive information system had been better designed to suit your tasks …	General
47	If there had been external courses on how to use the executive information system …	General
48	If the use of the executive information system had been voluntary …	General
49	If you had had a better understanding of the use of computers …	General
50	If there had been back-end support for executive information system users …	General
51	If the executive information system had offered clear and precise help …	EIS
52	If you had participated in the executive information system's development …	General
53	If the executive information system could have been customized …	General
54	If the system graphics had been better …	General
55	If the executive information system had been more important …	General
56	If you had been involved in the executive information system's design …	General
57	If you had been trained on computer usage …	General
58	If you had had more time to play with and explore the executive information system …	General
59	If there had been organizational polices supporting the executive information system ...	General
60	If there had been no implementation gap …	General
61	If you had participated in the training program …	General
62	If there had been social pressure to use the executive information system …	General
63	If your computer skills had been better …	General
64	If your perception of your role as an executive had been different …	General
65	If the terminology used in the executive information system had been clearer …	General
66	If it had been easier to understand the information model used …	EIS
67	If you had been better able to innovate…	General
68	If management had been more supportive during the project's implementation …	General
69	If the executive information system had been more accurate …	General
70	If the developer had been more responsive …	General
71	If there had been greater political pressure …	General
72	If the executive information system had contributed more to your job performance …	General
73	If there had been internal training programs for the executive information system …	General
74	If it had been easier to access the executive information system …	General
75	If there had been organizational support on the executive information system …	General
76	If you had identified the decision-making criteria you wanted to use …	General
77	If other colleagues had had influence …	General
78	If it had been easier to browse the executive information system …	General
79	If the executive information system had included "What if" functionalities …	General
80	If the executive information system had been more attractive …	General
81	If the executive information system had needed less response time …	General
82	If access to the executive information system director had been easier ...	General
83	If you had been less anxious about using computers …	General
84	If the executive information system had offered greater security …	General
85	If the first screen had contained the most important information about all key areas …	EIS
86	If you had felt happier using the executive information system …	General
87	If you had participated during the implementation project …	General

88	If your colleagues had used the system more …	General
89	If the executive information system had had a "map-like function" in case you got lost …	EIS
90	If the executive information system had been compatible with other executive information systems …	General
91	If there had been conditions making it easier to access the executive information system …	General
92	If there had been fewer perceived risks during the project's implementation …	General
93	If you had known how the calculations were done (having the option to check them) …	EIS
94	If the executive information system information had been updated more often …	General

Table 5: List of factors and their origins

d. Step 3: Statement structuring

This is the part of the research in which the executives are involved the most. As such, I decided to run a pilot test to uncover any possible problems executives might have and also determine how much time they would need to complete the task at hand. Two executives completed this pilot test in two different meetings. They needed an average of 40 minutes to finish it.

I gave them the personal questions on a form, followed by the 94 cards containing a statement each. I told them that they should classify these cards into different groups depending on how they made sense for them though with some restrictions: each card could only be included in one group; they could not put all the cards into a single group; and the individual cards could not be independent groups. And finally, I gave them the list of 94 factors and told them that they should rate each factor using a 1 to 5 scale based on the degree to which they would have likely used the Executive Information System depending on the condition described on each card (from “much less likely” – 1 – to “much more likely” – 5).

Some misinterpretations arose during these meetings so I decided to include general instructions on the first page of the survey and more detailed instructions in every survey section. As such, every senior executive participating received an envelope containing: the cover letter with the instructions and the study purpose, the survey itself and a smaller envelope with 94 cards and 12 paperclips.

The survey consisted of three parts:

- Part 1: instructions and the questions about executives' use of Executive Information Systems, their experience in using EIS, personal data and their company's information;
- Part 2: instructions on how to classify cards; and
- Part 3: instructions and the list of factors.

After they completed the survey and classified the cards, I asked them to put everything back in the envelope provided and return it to me.

The complete survey is attached as Annex 4.

i. Participant selection

In the various studies using Concept Mapping (W. M. K. Trochim, 1989b), we can find differences in the number of participants. As such, Trochim (1989b) recommends a group of between 8 and 15 heterogeneous participants to obtain the greatest number of points of view. Rosas (2005) works with 29 professionals and staff members, while Bigné et al. (2002) work with 15 consumers.

Sutherland and Katz (2005) refer in their research to some of Trochim's recommendations about the number of participants. They indicate that Trochim analyzed 38 Concept Mapping studies in a paper presented at the annual meeting of the American Evaluation Association in Dallas (TX) in 1993 and found a range of between 6 and 33 participants. Trochim is reported to have noted that the typically recommended sample size for concept mapping projects is 15 people. (I am aware that this is a secondary source but I did not have access to Trochim's original presentation).

I held 25 interviews. And, before the senior executives answered the survey questions, I discussed the definition of an Executive Information System with

them. The cover letter includes a definition from Britannica Academic Edition: “An information system is an integrated set of components for collecting, storing, processing, and communicating information.” In this study an Executive Information System is one kind of information system designed based on executives’ needs and used by executives. I decided to use this definition so that senior executives had a clearly sufficient idea about what an EIS is. There are some questions in the survey which also check to ensure that the system they are using (or used in the past) is (or was), in fact, an EIS.

In the survey carried out as part of this thesis, I included questions to test if the participating executives were senior executives as defined and asked several demographic questions to see if there were differences between these executives and others in terms of their EIS use.

Only 23 of these participants currently used an EIS or had used one in their previous jobs. As such, I decided to discard two interviews because those participants were not currently using an EIS and because they didn’t have experience with EIS. I provide descriptions of the 23 final participants in the following paragraphs.

There were 5 general managers in the group, 7 business unit directors, 5 functional area directors and 6 with other responsibilities.

There were 19 males and 4 females.

In terms of ages, there were 10 between 25 and 34, 9 between 35 and 44, and 4 over 45.

One of the executives had a PhD degree, 13 had a Master’s degree, 7 had a Bachelor’s degree and one a High School diploma.

I confirmed that these participants were involved in determining their organizations’ strategic direction. This was the case with all 23, and I could thus consider them to be “senior executives” as defined above.

On average, they had 14.6 years of working experience, one with 40 years' experience (the maximum in the group) and another with 7 (the minimum).

They had been working for their current firms 7.4 years on average. The maximum was 35 years. In addition, participants had occupied their current positions for 2.2 years on average.

When I asked them about what kind of information technology user they thought they were, one described himself/herself as a beginner, one as an expert, 10 as intermediate users, and 11 as advanced users.

The companies they work for cover a wide range of different industries: telecommunications, aerospace and defense, automotive, manufacturing, chemicals, financial services, consumer products, energy, tourism, health, and legal services.

All the executives work in Spain, except one who works in Andorra.

In terms of company size and the number of employees, 14 executives work in companies with more than 250 employees. And, in terms of sales volume, 13 work in companies with more than €50 million in revenues.

As regards the EIS systems the executives use or had used: 14 provide data in graphs, tables and text format, 10 provide internal and external information and data, 13 provide information in real time, 8 were designed based on their needs, 12 allow them to drill down from the aggregate information level to detailed information, 11 provide analytical functionalities, 6 provide them tendency analysis and, finally, 4 EIS provide them alerts about exceptions.

11 executives actually use the functionality to drill down from the aggregate level to detailed information, and 10 of them use the analytical functionalities.

Most of the systems they use are based on commercial solutions: 1 on Business Objects, 2 on Cognos, 3 on Microstrategy, 2 on Oracle, 1 on Microsoft, 1 on Hyperion, 1 on Information Builders, 4 on Excel, 3 on SAP, and one on an internal program.

And, finally, I asked about their use and experience with EIS. One of the executives said that he used his company's EIS 252 times a month, though the group average is 45.5 times per month, representing 23 hours a month on average. The participants also think that they use only 39% of the EIS's total functionalities on average.

When I asked about how they rated themselves as EIS system users, 1 of them rated himself or herself as a beginner, 10 as intermediate users, 11 as advanced users and 1 as an expert user.

The last question in this part was related to the executives' level of satisfaction with the EIS that they use or had used. The average score was a 5.3 on a scale from 0 to 10. As we can see, an average score of 5.3 out of 10 is not good news and only confirms that we need to know more about the EIS systems and senior executives.

ii. Statement sorting

I then gave executives the 94 cards inside an envelope with 15 paperclips. Their instructions were to: "Group cards in a way that makes sense for you," though some restrictions applied:

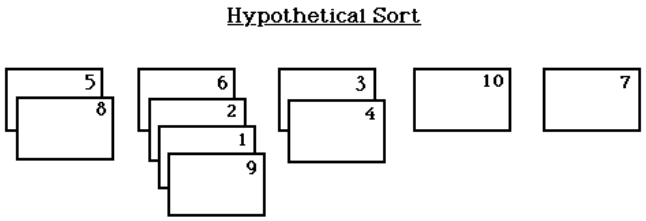
- Each statement can only be placed in one group;
- The statements cannot all be put into a single group; and,
- The statements cannot be their own individual group.

I also informed them that they shouldn't take into account the number on the cards. These numbers were only to facilitate analysis and had been assigned

randomly. Once they had classified all the cards, they were told to clip them together in their respective groups and put them back in the envelope provided.

As Trochim (1989b) indicated in his seminal paper and I couldn't say any better: "Once we have a set of statements which describes the conceptual domain for a given focus, we minimally need to provide information about how the statements are related to each other." He added, "When each person has completed the sorting task, the results must be combined across people."

This is accomplished in two steps. First, the results of how each executive sorted the statements are put into a square table or matrix which has as many rows and columns as there are statements. All of the values in this matrix are either zero or one. A '1' indicates that the statements for that row and column were placed by that person together in a group, while a '0' indicates that they were not. This is illustrated in Figure 7 for a person hypothetically sorting ten statements into 5 piles.



Binary Square Symmetric Similarity Matrix

	1	2	3	4	5	6	7	8	9	10
1	1	1	0	0	0	1	0	0	1	0
2	1	1	0	0	0	1	0	0	1	0
3	0	0	1	1	0	0	0	0	0	0
4	0	0	1	1	0	0	0	0	0	0
5	0	0	0	0	1	0	0	1	0	0
6	1	1	0	0	0	1	0	0	1	0
7	0	0	0	0	0	0	1	0	0	0
8	0	0	0	0	1	0	0	1	0	0
9	1	1	0	0	0	1	0	0	1	0
10	0	0	0	0	0	0	0	0	0	1

Figure 7: Procedure to compute the binary and symmetric similarity matrix for one person from their card sort

In the above example, we can see that statements 5 and 8 were sorted together in a group. Therefore, in row 5 - column 8 and row 8 - column 5 the entries are '1'. Because statement 5 was not sorted with statement 6, row 5 - column 6 and row 6 - column 5 entries are '0'. This individual matrix is termed a binary symmetric similarity matrix. Notice that all of the diagonal values are equal to '1' because a statement is always considered to be sorted into the same group as itself.

After the senior executives finished sorting the 94 statements in my study, I added this information to an Excel spreadsheet indicating the groups for every senior executive; this is illustrated in Figure 8.

	A	B	C
1	Item	Card	1
2	1	If other executives had influenced you to use the executive information system ...	1
3	2	If the executive information system had been easier to remember...	2
4	3	If the executive information system screens had been designed better ...	3
5	4	If the quality of the executive information system information had been better ...	2
6	5	If the executive group had been more innovative ...	1
7	6	If the use of the executive information system had been a part of the organization's culture ...	1
8	7	If the executive information system had been easier to learn ...	2
9	8	If the executive information system had included an information confirmation mechanism ...	3
10	9	If you had been closer to sources of power ...	1
11	10	If there had been a problem and you could have used the executive information system to focus on the issue, disregarding the details, ...	2
12	11	If the executive information system could have been adapted to the different executive leadership styles ...	1

Figure 8: Spreadsheet with part of the groups for one interview

On another spreadsheet using a VLOOKUP formula, I obtained one matrix for every senior executive with 0 and 1 between the variables, as represented in Figure 9.

	A	B	C	D	E	F	G	H	I	J	K	L
1	1	1	2	3	4	5	6	7	8	9	10	1
2	1	1	0	0	0	1	1	0	0	1	0	
3	2	0	1	0	1	0	0	1	0	0	1	
4	3	0	0	1	0	0	0	0	1	0	0	
5	4	0	1	0	1	0	0	1	0	0	1	
6	5	1	0	0	0	1	1	0	0	1	0	
7	6	1	0	0	0	1	1	0	0	1	0	
8	7	0	1	0	1	0	0	1	0	0	1	
9	8	0	0	1	0	0	0	0	1	0	0	
10	9	1	0	0	0	1	1	0	0	1	0	
11	10	0	1	0	1	0	0	1	0	0	1	
12	11	1	0	0	0	1	1	0	0	1	0	

Figure 9: Part of a symmetric similarity matrix for interview number 1 from their card sort

In Figure 9, row 1 and column A indicate the factor number, while cell A1 indicates that this matrix is for interview number 1. As we can see, this senior executive put statements 1, 5, 6, 9, and 11 into the same group. So, in column B or row 2 (the same due to the symmetric similarity matrix) we can find a '1' between pairs 1-1, 5-1, 6-1, 9-1, and 11-1, and a '0' between 2-1, 3-1, 4-1, 8-1, 9-1 and 10-1 because factors 2, 3, 4, 8, 9, and 10 are not in the same group as factor 1.

And, as Trochim (1989b) said:

> Second, the individual sort matrices are added together to obtain a combined group similarity matrix. This matrix also has as many rows and columns as there are statements. Here, however, the value in the matrix for any pair of statements indicates how many people placed that pair of statements together in a pile regardless of what the pile meant to each person or what other statements were or were not in that pile. Values along the diagonal are equal to the number of people who sorted. Thus, in this square group similarity matrix, values can range from zero to the number of people who sorted. This final similarity matrix is considered the relational structure of the conceptual domain because it provides information about how the participants grouped the statements. A high value in this matrix indicates that many of the participants put that pair of statements together in a pile and implies that the statements are conceptually similar in some way. A low value indicates that the statement pair was seldom put together in the same pile and implies that they are conceptually more distinct.
>
> This is what I did as can be seen in Figure 10.

	A	B	C	D	E	F	G	H	I	J	K	L
1		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11
2	V1	23	4	3	1	10	12	2	2	6	2	9
3	V2	4	23	7	6	3	3	20	5	2	7	4
4	V3	3	7	23	9	8	2	8	14	6	7	4
5	V4	1	6	9	23	5	5	5	9	5	7	5
6	V5	10	3	8	5	23	11	5	7	9	5	8
7	V6	12	3	2	5	11	23	2	1	6	5	10
8	V7	2	20	8	5	5	2	23	7	4	6	3
9	V8	2	5	14	9	7	1	7	23	5	9	4
10	V9	6	2	6	5	9	6	4	5	23	7	7
11	V10	2	7	7	7	5	5	6	9	7	23	5
12	V11	9	4	4	5	8	10	3	4	7	5	23

Figure 10: Part of the added symmetric similarity matrix for all the interviewees

The interpretation of every cell is the number or times that the senior executives grouped two factors together. In the matrix diagonal there is a ’23’, representing the number of the interviewees because every factor will always be in the same group with itself. Additionally, a ‘3’ appears in the pair V1 and V3. This means that 3 of the executives placed factor 1 and factor 3 in the same group of cards.

iii. Statement rating

After the executives finished grouping the cards, I then asked them to rate every phrase or statement using a Lykert-type response scale (1-to-5). Specifically, executives had to use the following scale (from “much less” – 1 – to “much more” – 5) to indicate how much more likely they would have used the Executive Information System depending on the different conditions:

1. Much less
2. Less
3. No more, no less
4. More
5. Much more

All the factors are presented in a positive manner; I did so to facilitate the comparison between factors.

e. Step 4: Statement representation (map computation)

The main objective of this step is show the relationship between the factors. As Trochim (1989b) indicates:

> There are three steps involved in the way in which we typically represent the conceptual domain. First, we conduct an analysis which locates each statement as a separate point on a map (i.e., the point map). Statements which are closer to each other on this map were likely to have been sorted together more frequently; more distant statements on the map were in general sorted together less frequently. Second, we group or partition the statements on this map into clusters (i.e., the cluster map) which represent higher order conceptual groupings of the original set of statements.

Finally, we can construct maps which are above the averaged ratings either by point (i.e., the point rating map) or by cluster (i.e., the cluster rating map).

i. Point map

To accomplish the first step, the mapping process, I carried out a two-dimensional non-metric multidimensional scaling of the similarity matrix obtained from Step 3 above.

Multidimensional scaling enables researchers to understand the similarity between objects (Hair, Black, Babin, Anderson, & Tatham, 2006). Non-metric multidimensional scaling is a technique which takes a proximity matrix and represents it in any number of dimensions as distances between the original items in the matrix (W. M. K. Trochim, 1989b). To do this I used IBM SPPS Statistics release 20.0.0. and the PROXSCAL multidimensional scaling option, included in the Categories SPSS module. Trochim (1989b) proposed ALSCAL, but other studies have demonstrated that ALSCAL is sub-optimal (Ramsay, 1982). I depict the result of this scaling in Figure 11.

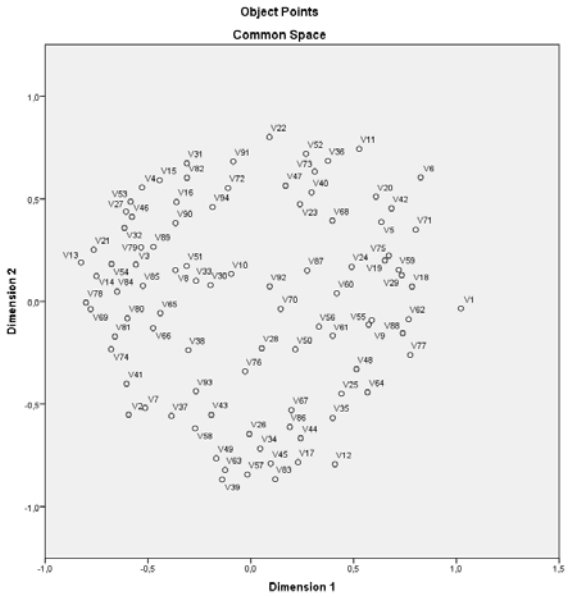


Figure 11: The point map

Every dot represents a single factor. I coded all the factors with the letter 'V' plus the number of the factor. The interpretation of the point map is as follows: the closer two variables are in this map, the greater their similarity according to the senior executives interviewed. The position of each point on the map (e.g., top, bottom, right, left) is not important. The only important question here is the distance or spatial relationship between the different points.

As can be seen in Figure 12 below, the goodness of fit of these results is 'poor' (Stress-I 0.30769 >0.20) in keeping with Shepard and Kruskal (1964). However, the Dispersion Accounted for is 0.90533, and Trucker's Coefficient of Congruence is close to 1. Bartholomew, Steele, Moustaki and Galbraith (2008) consider that Shepard and Kruskal "based their studies on empirical experience rather than theoretical criteria." As such, Bartholomew et al. (2008) believe that goodness of fit "should always be used flexibility with an eye on interpretability of the solution which you lead." In the next sections I discuss the interpretability of the results obtained.

Stress and Fit Measures

Normalized Raw Stress	,09467
Stress-I	,30769[a]
Stress-II	,73280[a]
S-Stress	,20850[b]
Dispersion Accounted For (D.A.F.)	,90533
Tucker's Coefficient of Congruence	,95149

PROXSCAL minimizes Normalized Raw Stress.

a. Optimal scaling factor = 1,105.

b. Optimal scaling factor = ,914.

Figure 12: Stress and fit measures

ii. Cluster map

The second analysis I conduct to represent the conceptual domain is called a hierarchical cluster analysis. This analysis is used to group individual

statements onto a map of statement clusters which presumably reflect similar concepts (W. M. K. Trochim, 1989b). Cluster analysis defines the structure by grouping objects according to their profiles on a set of variables (the cluster variables) in which objects in close proximity to each other are grouped together (Hair et al., 2006). In this research, I used a hierarchical agglomerative cluster analysis using Ward's algorithm on the Multidimensional Scaling (MDS) map coordinates to determine how the statements cluster together based on their similarities.

I applied a 20-to-8 cluster analysis (using IBM SPPS Statistics) to decide on the appropriate cluster solution. This analysis begins with each statement as its own cluster and tracks the merging of the statements into clusters up to a 20-cluster solution. The output from this analysis generates two outputs: 1) a list of the 20-8-cluster solution; and 2) the merging of clusters for each cluster solution (a list version of a dendogram). The two outputs together help guide our analysis about the goodness of fit for the final cluster solution.

As Jackson and Trochim (2002) indicate:

> Each proposed cluster solution is then examined to determine how appropriate the merging or splitting of statement groups is. A final cluster solution is chosen by examining all of the cluster solutions within a certain range to determine how appropriate the merging or splitting of statement groups is. It is important to note that the central decision being made here is on the number of clusters to select—the hierarchical cluster tree structure is entirely determined by the analysis and is not the subject of researcher discretion or judgment. The reason such judgment is required with cluster analysis is that there is no sensible mathematical criterion that can be used to select the number of clusters. This is because the "best" number of clusters depends on the level of specificity desired and the context at hand, factors that can only be judged subjectively. So this issue of cluster number selection illustrates how concept mapping is a blending of human judgment based on the more objective mathematical algorithm of cluster analysis".

This coincides with Hair et al. (2006) who indicate that, when not finding a systematic trait which determines the number of clusters, researchers can then decide to establish a number of clusters in which merely statistical groupings also provide a conceptual meaning coherent with the ideas contained in each group.

I thus decided that a 12-cluster solution was the most appropriate solution as depicted in Figure 13.

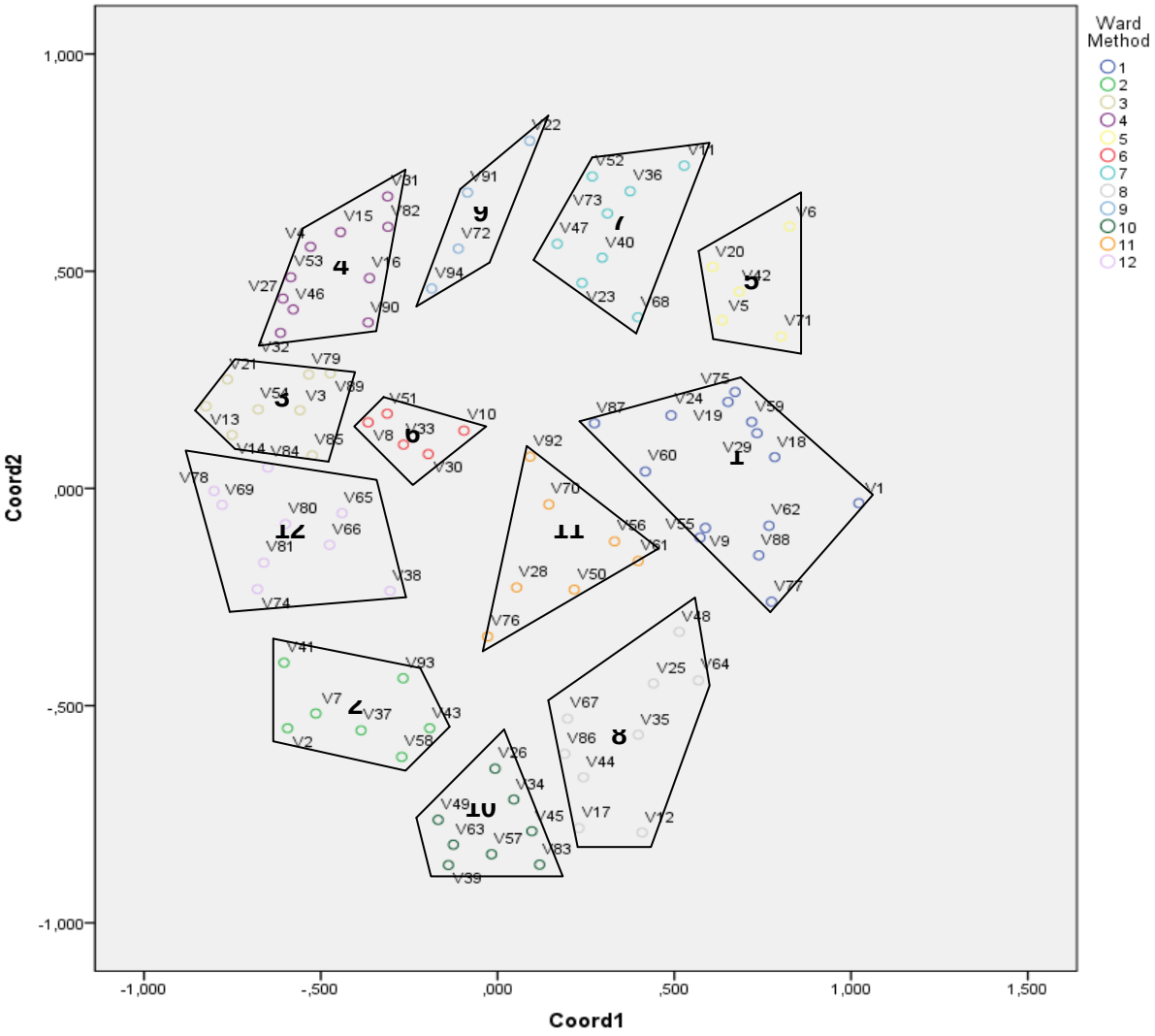
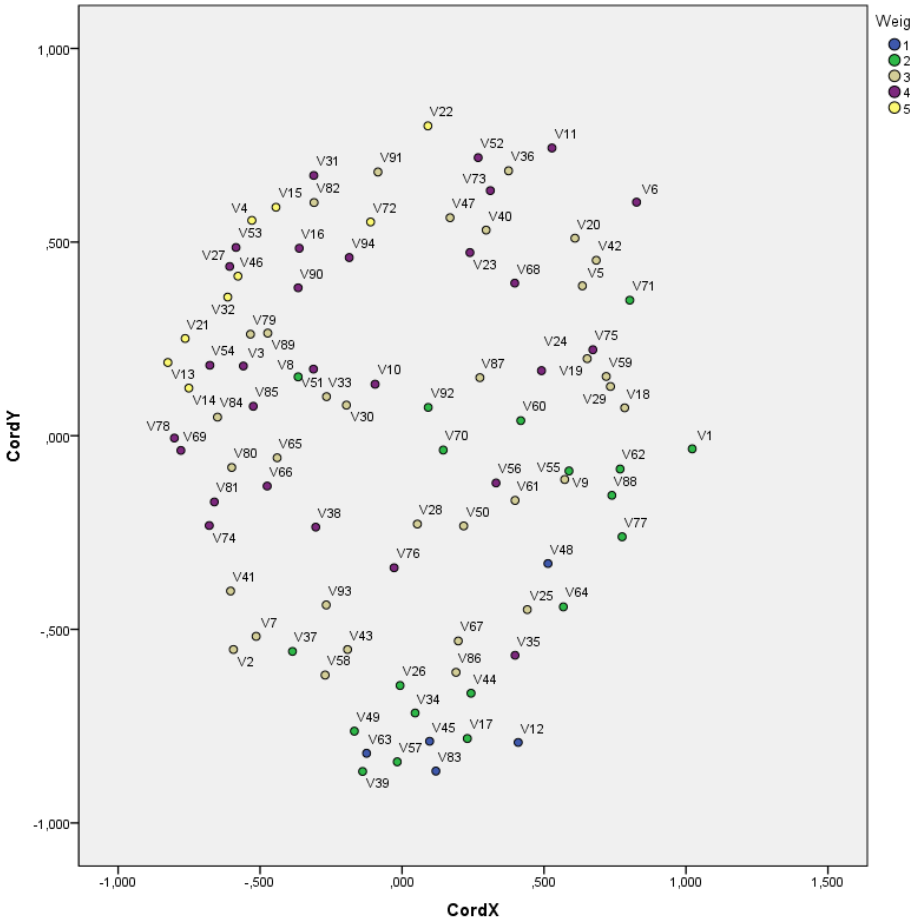


Figure 13: The cluster map

After conducting the multidimensional scaling and cluster analysis, I was able to generate a point and a cluster map as indicated by Trochim (1989b). The final analysis involves obtaining average ratings across participants for each statement and for each cluster.

iii. Point rating map

The point rating map shows the importance of every single factor. They are organized into 5 groups of importance as we can see in Figure 14.



1	between	2.57	and	2.96
2	between	2.96	and	3.35
3	between	3.35	and	3.74
4	between	3.74	and	4.13
5	between	4.13	and	4.52

Figure 14: The point rating map

iv. Cluster rating map

The cluster rating map shows the importance of every cluster. They are organized into 5 groups of importance, as detailed in Figure 15.

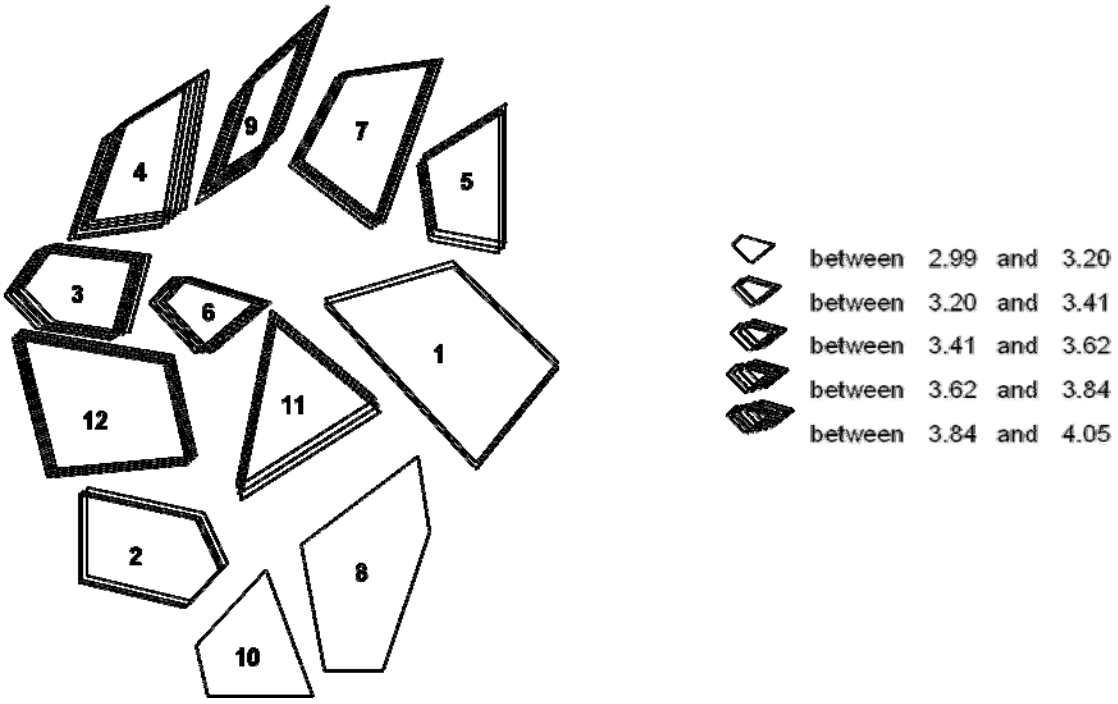


Figure 15: The cluster rating map

f. Reflection on the methodology used

I have adapted the original Concept Mapping methodology from Trochim (1989b) to answer the second and third research question as I discuss in the next sections. This methodology allows senior executives to group and rate the factors. But, to answer my first research question, I need to compare the median rated values for factors coming from the interviews and from the literature review. Concept Mapping does not provide this as I discuss in the next sections. As such, I combine Concept Mapping (qualitative and quantitative) with other quantitative methods.

As Morgan (1998) argued:

> The core of this approach [combining qualitative and quantitative methods] is an effort to integrate the complementary strengths of different methods through a division of labor. This amounts to using a qualitative and quantitative method for different but well coordinated purposes within the same overall research project. This division of labor is accomplished through two basic decisions: a priority decision that pairs a principal method with a complementary method and a sequence decision that

determines whether the complementary method precedes or follows the principal method.

The main advantage of Concept Mapping is that this methodology mixes qualitative and quantitative methods in keeping with Morgan (1998). My priority decision was to use Concept Mapping from Trochim (1989b). The qualitative method in Concept Mapping allowed me to find the factors to be compared to the factors from the literature review. By contrast, the quantitative method in Concept Mapping allowed me to obtain the data to answer my first research question and answered my second and third research questions. The interviews with senior executives to identify the factors that they considered could affect their use of EIS were critical to be to compare them later with the literature review factors.

Another interesting lesson learned came from the process of selecting the factors in the literature review. I recorded 347 factors in total. As this is a difficult number of factors to manage, I added some general labels to find similarities and work with groups that were more manageable. This step also enabled providing traceability to every factor.

The application of Concept Mapping in my research has some limitations, as we can see. The choice to use Concept Mapping implies, as Trochim recommends (1989b), between 15 and 30 subjects to be studied. In those cases when you need a higher number to increase validity, you should design the study with different groups. This research design has done that and offers added value in that, by comparing results from different groups, researchers can clearly show the reliability of their research. My study has one limitation due to the fact that it is only based on one group. Some of the senior executives also noted during this study that “it’s not easy to group 94 cards.”

5. Analysis and findings

In this section I present my analysis and main findings of my research. This section includes the 6 sections withinstep number 5 in the adapted Concept Mapping methodology, namely, “Map interpretation” as presented in Section 4 under “Research methodology.”

i. Statement list

In keeping with Trochim’s recommendations (1989b), I obtained the mean ratings for the statements, their standard deviation and ordered them by their scores. Results are shown in Table 6 ordered by the factors’ importance (mean score) in terms of their probability of increasing senior executives’ use of EIS systems.

Factor number	Factor	Factor origins	Mean	Standard deviation	Rank
13	If the executive information system had included the information you needed …	EIS	4.52	0.79	1
32	If it had been easy to interpret the information in the executive information system’s graphs, tables, reports, etc. …	EIS	4.43	0.66	2
72	If the executive information system had contributed more to your job performance …	General	4.39	0.84	3
4	If the quality of the executive information system information had been better …	General	4.35	0.78	4
14	If the executive information system had been more reliable …	General	4.35	0.65	4
21	If you had needed less time to find the information required …	EIS	4.26	0.69	6
46	If the executive information system had been better designed to suit your tasks …	General	4.22	0.80	7
22	If the executive information system and the business objectives had been better linked …	General	4.17	0.98	8
15	If the executive information system had offered a greater wealth of information …	General	4.13	0.81	9
27	If the executive information system had had a drill-down function, enabling you to go from aggregated information to detailed data, …	EIS	4.09	0.67	10
53	If the executive information system could have been customized …	General	4.09	0.85	10
10	If there had been a problem and you could have used the executive information system to focus on the issue, disregarding the details, …	EIS	4.04	0.82	12
16	If the executive information system had included more external information ...	General	4.00	1.15	13
31	If the executive information system had been multidimensional in terms of functionality …	EIS	4.00	0.85	13
75	If there had been organizational support on the executive information system …	General	4.00	0.80	13
85	If the first screen had contained the most important information about all key areas …	EIS	4.00	0.95	13
6	If the use of the executive information system had been a part of the organization’s culture ...	General	3.96	0.93	17
51	If the executive information system had offered clear and precise help …	EIS	3.96	0.88	17
56	If you had been involved in the executive information system’s design …	General	3.96	0.98	17
52	If you had participated in the executive information system’s development …	General	3.91	0.95	20
68	If management had been more supportive during the project's implementation …	General	3.91	0.90	20
73	If there had been internal training programs for the executive information system …	General	3.91	0.73	20
35	If you had trusted the executive information system …	General	3.87	0.81	23
69	If the executive information system had been more accurate …	General	3.86	0.89	24

3	If the executive information system screens had been designed better …	General	3.83	0.94	25
66	If it had been easier to understand the information model used …	EIS	3.83	0.83	25
74	If it had been easier to access the executive information system …	General	3.83	0.78	25
81	If the executive information system had needed less response time …	General	3.83	0.78	25
90	If the executive information system had been compatible with other executive information systems …	General	3.83	0.94	25
23	If the project's implementation process had been better…	General	3.78	0.67	30
24	If the project's implementation had been incremental …	General	3.78	0.74	30
76	If you had identified the decision-making criteria you wanted to use …	General	3.78	1.00	30
94	If the executive information system information had been updated more often …	General	3.78	0.80	30
11	If the executive information system could have been adapted to the different executive leadership styles …	General	3.74	0.81	34
38	If it had been easier to know what information the executive information system contained …	EIS	3.74	0.92	34
54	If the system graphics had been better …	General	3.74	1.01	34
78	If it had been easier to browse the executive information system …	General	3.74	0.69	34
20	If the project had had more visibility …	General	3.70	0.97	38
30	If the system's infrastructures had been better …	General	3.70	0.82	38
36	If resources had been available for the executive information system …	General	3.70	0.76	38
40	If the designers had instilled a more favorable attitude among executives by involving them during the implementation project …	General	3.70	0.76	38
41	If it had been less difficult to use the executive information system …	General	3.70	0.93	38
58	If you had had more time to play with and explore the executive information system …	General	3.70	1.06	38
87	If you had participated during the implementation project …	General	3.70	0.97	38
28	If you had had support from information specialists …	General	3.65	0.88	45
50	If there had been back-end support for executive information system users …	General	3.65	0.78	45
65	If the terminology used in the executive information system had been clearer …	General	3.65	0.83	45
42	If the organization had used the executive information system more …	General	3.61	0.89	48
55	If the executive information system had been more important …	General	3.61	0.72	48
91	If there had been conditions making it easier to access the executive information system …	General	3.61	0.78	48
19	If there had been organizational pressure to use the executive information system …	General	3.57	0.90	51
59	If there had been organizational polices supporting the executive information system ...	General	3.57	0.79	51
79	If the executive information system had included "What if" functionalities …	General	3.57	0.84	51
80	If the executive information system had been more attractive …	General	3.57	0.66	51
84	If the executive information system had offered greater security …	General	3.57	0.73	51
89	If the executive information system had had a "map-like function" in case you got lost …	EIS	3.52	0.73	56
5	If the executive group had been more innovative …	General	3.48	0.85	57
7	If the executive information system had been easier to learn …	EIS	3.48	1.08	57
25	If you had felt greater cultural affinity with the executive information system ...	General	3.48	0.99	57
61	If you had participated in the training program …	General	3.48	0.73	57
67	If you had been better able to innovate…	General	3.48	0.85	57
86	If you had felt happier using the executive information system …	General	3.48	1.12	57
2	If the executive information system had been easier to remember…	EIS	3.43	1.04	63
47	If there had been external courses on how to use the executive information system …	General	3.43	0.95	63
18	If someone had demonstrated the positive results obtained from using the executive information system …	General	3.39	1.16	65
29	If there had been institutional control over the executive information system's use ...	General	3.39	0.89	65
33	If the executive information system had had the same functionalities as Windows or the Internet …	EIS	3.39	1.16	65
43	If you had had more experience with the executive information system …	General	3.35	0.78	68
82	If access to the executive information system director had been easier ...	General	3.35	0.71	68
93	If you had known how the calculations were done (having the option to check them) …	EIS	3.35	0.65	68
70	If the developer had been more responsive …	General	3.32	0.78	71
9	If you had been closer to sources of power …	General	3.22	0.90	72

37	If you had perceived that the executive information system was less complex …	General	3.22	1.04	72
71	If there had been greater political pressure …	General	3.22	1.04	72
1	If other executives had influenced you to use the executive information system …	General	3.17	1.03	75
39	If you had been better at using the executive information system …	General	3.17	0.78	75
64	If your perception of your role as an executive had been different …	General	3.13	0.87	77
8	If the executive information system had included an information confirmation mechanism …	General	3.09	0.85	78
26	If you had been more predisposed to using computers …	General	3.09	0.90	78
60	If there had been no implementation gap …	General	3.09	0.90	78
62	If there had been social pressure to use the executive information system …	General	3.09	0.85	78
34	If your ability to concentrate had been better …	General	3.04	0.64	82
49	If you had had a better understanding of the use of computers …	General	3.04	0.93	82
57	If you had been trained on computer usage …	General	3.04	0.98	82
77	If other colleagues had had influence …	General	3.04	0.88	82
88	If your colleagues had used the system more …	General	3.04	0.82	82
44	If you hadn't been reluctant to spend extra time learning how to use applications other than spreadsheets ...	General	3.00	0.74	87
17	If you had been less defensive …	General	2.96	0.88	88
92	If there had been fewer perceived risks during the project's implementation …	General	2.96	0.56	88
45	If you had been more computer literate …	General	2.91	0.90	90
63	If your computer skills had been better …	General	2.87	0.92	91
48	If the use of the executive information system had been voluntary …	General	2.74	0.81	92
83	If you had been less anxious about using computers …	General	2.74	0.86	92
12	If you had suffered from job insecurity ...	General	2.57	0.95	94

Table 6: Factors ordered by mean score

The highest rated factor is statement number 13: “If the executive information system had included the information you need...,” with an average score of 4.52 on a five-point scale. The statement receiving the lowest rating is number 12, “If you had suffered from job insecurity...,” with an average score of 2.57. Given these scores, we can affirm that senior executives consider that all the factors would positively affect their use of EIS.

The maximum standard deviation is 1.16. There are two factors with this value: numbers 18 and 33, “If someone had demonstrated the positive results obtained from using the executive information system …” and “If the executive information system had had the same functionalities as Windows or the Internet …”, respectively. The lowest standard deviation (0.56) is for statement number 92, “If there had been fewer perceived risks during the project's implementation …”

In Table 7 I detail all the factors' main descriptives for average and standard deviation.

Descriptives

			Statistic	Std. Error
Average	Mean		3.5892	.04318
	95% Confidence Interval for Mean	Lower Bound	3.5034	
		Upper Bound	3.6749	
	5% Trimmed Mean		3.5897	
	Median		3.6300	
	Variance		.175	
	Std. Deviation		.41867	
	Minimum		2.57	
	Maximum		4.52	
	Range		1.95	
	Interquartile Range		.57	
	Skewness		-.111	.249
	Kurtosis		-.398	.493
StandardDev	Mean		.8579	.01282
	95% Confidence Interval for Mean	Lower Bound	.8324	
		Upper Bound	.8833	
	5% Trimmed Mean		.8551	
	Median		.8500	
	Variance		.015	
	Std. Deviation		.12430	
	Minimum		.56	
	Maximum		1.16	
	Range		.60	
	Interquartile Range		.16	
	Skewness		.257	.249
	Kurtosis		-.053	.493

Table 7 List of descriptives for factors' average and standard deviation

Table 8 details results if we carry out the same analysis on the two groups of factors (those stemming from interviews are labeled 'EIS' while those from the literature review 'General').

Descriptives

				Statistic	Std. Error
Average	EIS	Mean		3.8696	.09759
		95% Confidence Interval for Mean	Lower Bound	3.6603	
			Upper Bound	4.0789	
		5% Trimmed Mean		3.8623	
		Median		3.9565	
		Variance		.143	
		Std. Deviation		.37796	
		Minimum		3.35	
		Maximum		4.52	
		Range		1.17	
		Interquartile Range		.61	
		Skewness		.154	.580
		Kurtosis		-1.019	1.121
	General	Mean		3.5359	.04575
		95% Confidence Interval for Mean	Lower Bound	3.4449	
			Upper Bound	3.6270	
		5% Trimmed Mean		3.5368	
		Median		3.6100	
		Variance		.165	
		Std. Deviation		.40665	
		Minimum		2.57	
		Maximum		4.39	
		Range		1.82	
		Interquartile Range		.66	
		Skewness		-.153	.271
		Kurtosis		-.491	.535
StandardDev	EIS	Mean		.8481	.04100
		95% Confidence Interval for Mean	Lower Bound	.7602	
			Upper Bound	.9360	
		5% Trimmed Mean		.8421	
		Median		.8341	
		Variance		.025	
		Std. Deviation		.15878	
		Minimum		.65	
		Maximum		1.16	
		Range		.51	
		Interquartile Range		.26	
		Skewness		.502	.580
		Kurtosis		-.611	1.121
	General	Mean		.8597	.01325
		95% Confidence Interval for	Lower Bound	.8334	

	Mean	Upper Bound	.8861	
	5% Trimmed Mean		.8580	
	Median		.8500	
	Variance		.014	
	Std. Deviation		.11779	
	Minimum		.56	
	Maximum		1.16	
	Range		.60	
	Interquartile Range		.16	
	Skewness		.200	.271
	Kurtosis		.167	.535

Table 8: List of descriptives for average and standard deviation depending on factors' origins

As we can see, the standard deviation is more or less similar regardless of the factors' origin. However, this is not the case with the mean. In Table 9 I analyze the mean and the rank positions of these two origins (EIS interviews and literature review).

	Mean	Top 10 factors	Top 20 factors	Total
Interview factors 'EIS'	3.8696	4 (26.6%)	8 (53.3%)	15 (100%)
Literature review factors 'General'	3.5359	7 (8.9%)	14 (17.7%)	79 (100%)
Total factors	3.5892	11	22	94

Table 9: Factors' mean, top 10 and top 20 rankings

In spite of the limited number of senior executives participating, we can observe that the kind of information system and their users are important because the mean is higher. And, if we analyze the top 20 factors ranked, 53.3% of the interview (EIS) factors are included among the top 20 factors.

Figure 16 below provides a graphic representation of all the factors on the point map that come from the interviews.

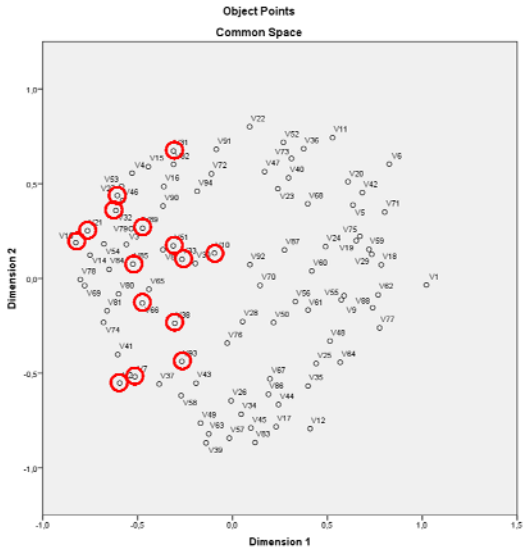


Figure 16: Interview factors in red

Most of these factors are in the zone with the highest average scores, as can be seen in the cluster rating map (Figure 13). Now we have to test if the difference between the two groups of factors is statistically significant. The null hypothesis is that they are equal, so the alternative hypothesis is that they are different. To carry out this test, I did a comparison of means. We can assume the normality of the two groups as a condition to compare the means. Results are detailed in Figure 17.

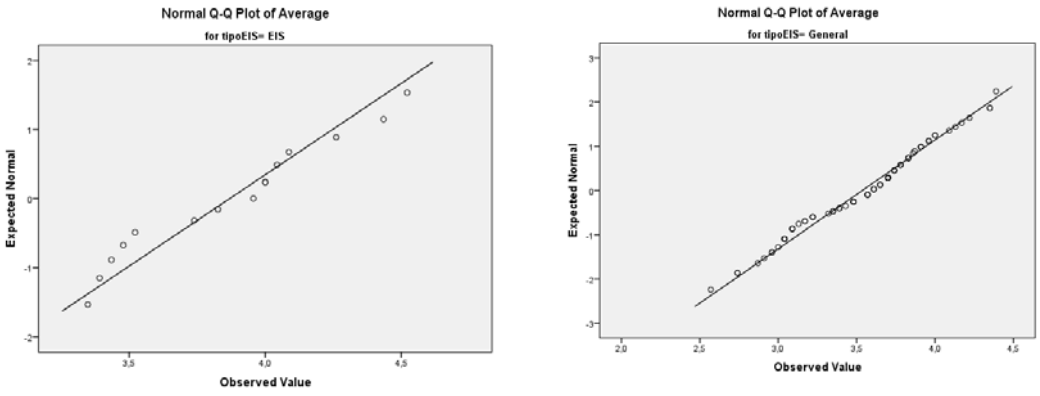


Figure 17: Graphs for normality of the two groups of factors

In Figure 18 we can see the box plot graph showing the two groups.

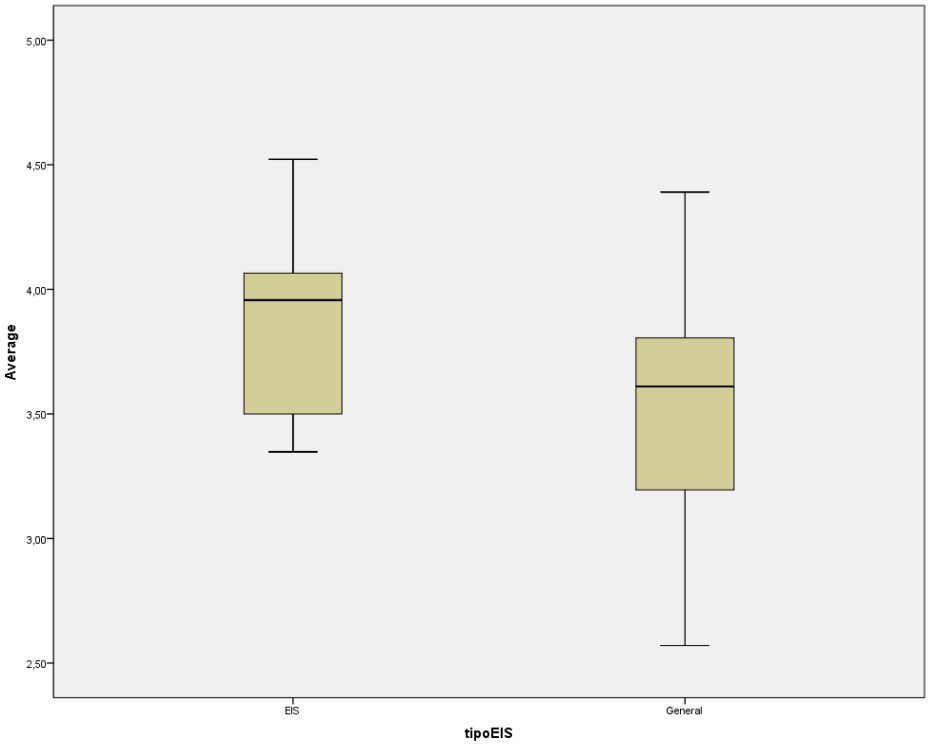


Figure 18: Box plot graph for the two groups of variables

And, lastly, I detail T-test results in Table 10.

		Levene's Test for Equality of Variances		T-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Average	Equal variances assumed	.099	.754	2.943	92	.004	.33362	.11334	.10851	.55872
	Equal variances not assumed			3.095	20.651	.006	.33362	.10778	.10924	.55799

Table 10: T-test results

The p-value in Levene's Test for equality of variances is 0.754 (>0.05). We can thus assume that the variances are equal. In this case, the significance of the T-test is 0.004 (<0.05). As such, I had to reject the null hypothesis. **The test demonstrated that the mean of the variables is not equal. The group of factors stemming from the interviews thus has a greater effect on senior executives' use of EIS systems than the factors from the literature review. This is the affirmative answer to my first research question.**

ii. Cluster list and names

I have named all the clusters and ordered and calculated the average of each group.

To name the clusters, I included all the factors on post-its and stuck them on a glass wall as we can see in Figure 19. They are placed according to their respective positions on the point map (see Figure 9 above).

Figure 19: Picture of the factors on a glass wall

I did this in order to facilitate the interpretation of every cluster, taking into account the centered factors for every cluster, their position on the map and their relative position compared to other clusters.

This exercise helped me understand the interpretation of the map dimensions as I discuss in the next sections.

The cluster names and their descriptions are as follows:

1. ***EIS organizational behavior***: this cluster is related to organizational support, organizational polices and resources, EIS use, influence and recommendations from peers, pressure to use it, control, peer usage and importance of EIS in the organization. The highest average score is 4.00 for factor number 75: “If there had been organizational support for the executive information system …” Two factors tie with the lowest average score: factors 77 and 88, namely, “If other colleagues had had influence …” and “If your colleagues had used the system more …” This cluster is in position number 10 (out of 12 clusters) in the ranking of averages compared to the rest of the clusters with an average score of 3.40. The most centered factor in the cluster is number 62, “If there had been social pressure to use the executive information system …”

2. ***EIS ease of use***: this cluster includes factors such as that the EIS is less difficult to use, easy to remember and learn, less complex, more time to play with and explore with the EIS, and the traceability of calculations. The highest average factor score in the cluster is 3.70, with a tie between factors 41 and 58: “If it had been less difficult to use the executive information system …” and “If you had had more time to play with and explore the executive information system …,” respectively. This cluster received an average score of 3.46 and is in position number 9 in the ranking of the averages compared to the rest of the clusters. The most centered factor in the cluster is number 37, “If you had perceived that the executive information system was less complex …”

3. ***EIS design***: this cluster includes information that users need, reliability, screens, graphics, first screen with the most important information, “map-like” function, less time to find the information that you need, etc. Factor number 13, “If the executive information system had included the information you needed …”, is ranked the highest, with a 4.52, while factor 89, “If the executive information system had had a "map-like function" in case you got lost …,” received the lowest average score with a 3.52. This cluster occupies position number 3 out of 12 in the ranking of clusters and has an average score of 3.97. The most centered factor in the cluster is number 54, “If the system graphics had been better …”

4. ***EIS content and access to information***: this cluster includes factors such as the EIS is easy to interpret (graphs, tables, reports), quality of the EIS, adapted to senior executives’ tasks, greater wealth of information, drill-down function, user customization, compatibility with other EIS, and access to the EIS director. Factor number 32, “If it had been easy to interpret the information in the executive information system’s graphs, tables, reports, etc. …,” scored the highest with a 4.43. Factor 82, “If access to the executive information system director had been easier ...,” scored the least, with a 3.35. This cluster occupies the top position with the highest average score: 4.05. The most centered factor in this cluster is number 15, “If the executive information system had offered a greater wealth of information …”

5. ***Importance of EIS use in the organization***: this cluster includes factors such as if EIS is a part of the organization’s culture, EIS project visibility, EIS use, executives’ innovativeness and political pressure. The highest average score is 3.96 for factor 6, “If the use of the executive information system had been a part of the organization's culture ...” The factor with the lowest average score is number 71, “If there had been greater political pressure …” This cluster holds position number 7 with an average score of 3.59. This is the same rating as the average of all the factors. The most centered factor in the cluster is number 42, “If the organization had used the executive information system more …”

6. ***EIS confidence***: this cluster includes the capacity to access the information to solve problems with the EIS, clear and precise help, infrastructures, information confirmation mechanisms, and the same functionalities as Windows or Internet. The highest averaged factor is number 10, “If there had been a problem and you could have used the executive information system to focus on the issue, disregarding the details…” The lowest rated factor is number 8, “If the executive information system had included an information confirmation mechanism …” This cluster holds position number 6 with an average score of 3.63. The most centered factor in the cluster is number 33, “If the executive information system had had the same functionalities as Windows or the Internet …”

7. ***Executives’ involvement in EIS***: this cluster includes executives’ participation in EIS development, management support for the project, internal and external courses, implementation process, designers’ attitudes, and adaptability to different executive leadership styles. There is a triple tie with respect to the highest averaged factors: number 52, “If you had participated in the executive information system's development …”, number 68, “If management had been more supportive during the project's implementation …,” and number 73, “If there had been internal training programs for the executive information system …” This cluster holds position number 4 out of 12 with an average score of 3.76. The most centered factor in the cluster is number 73, “If there had been internal training programs for the executive information system …”

8. ***Executives’ attitudes***: this cluster includes executive trust in the EIS, executive innovation, cultural affinity to the EIS, pleasure in using the EIS, role perception, reluctance to spend extra time learning the EIS, less defensive attitudes and job insecurity. There is a triple tie between the highest average factors: number 25, “If you had felt greater cultural affinity with the executive information system ...”, number 67, “If you had been better able to innovate…,” and number 86, “If you had felt happier

using the executive information system …" The lowest scoring factor is number 12, "If you had suffered from job insecurity ..." This cluster occupies position number 11 with an average score of 3.19. The most centered factor in the cluster is number 35, "If you had trusted the executive information system …"

9. ***EIS focus***: this cluster includes the EIS' contribution to the executives' job performance and linkage with business objectives, as well as ability to access the EIS and time to update. Factor 72, "If the executive information system had contributed more to your job performance …," is scored the highest with a 4.39. The poorest scoring factor in this cluster is number 91, "If there had been conditions making it easier to access the executive information system …" This cluster holds position number 2 out of 12 with an average score of 3.99. The most centered factor in this cluster is number 72, "If the executive information system had contributed more to your job performance …"

10. ***Executives' ability to use EIS***: this cluster includes the executives' ability to use the EIS, executive predisposition to use computers, executives' ability to concentrate, executives' training and understanding of the use of computers, executive computer literacy and skills and their anxiousness when using computers. The highest averaged factor is number 39, "If you had been better at using the executive information system …" The factor with the lowest average is number 83, "If you had been less anxious about using computers …" This cluster occupies position number 12 with an average score of 2.99. The most centered factor in the cluster is number 57, "If you had been trained on computer usage …"

11. ***Executives' proximity to EIS***: this cluster includes executive participation in EIS design and in decision-making criteria, availability of information specialists and back-end support, participation in the training program, relationship with the developer and lower perceived risk during the project's implementation. The factor with the highest score is number

56, “If you had been involved in the executive information system's design …” The factor with the lowest score is number 92, “If there had been fewer perceived risks during the project's implementation …” This cluster is ranked 8 of 12 with an average score of 3.54. The most centered factor in the cluster is number 70, “If the developer had been more responsive …”

12. ***EIS accessibility***: this cluster includes factors such as EIS accuracy, it is easy to understand, access, easy to find information and browse, as well as lower response time, clear terminology, EIS attractiveness and security. The highest averaged factor is number 69, “If the executive information system had been more accurate …” The lowest rated factors are number 80, “If the executive information system had been more attractive …,” and number 84, “If the executive information system had offered greater security …” This cluster occupies position number 5 out of 12 with an average score of 3.73. The most centered factor in the cluster is number 80, “If the executive information system had been more attractive …”

The names of the clusters are the answer to my second research question, as we can see in more detail in section 6 below.

Table 11 below details the complete list of factors and clusters.

Cluster name	Factor number	Factor	Mean	Factor origins
EIS Organizational behavior				
	1	If other executives had influenced you to use the executive information system …	3.17	General
	9	If you had been closer to sources of power …	3.22	General
	18	If someone had demonstrated the positive results obtained from using the executive information system …	3.39	General
	19	If there had been organizational pressure to use the executive information system …	3.57	General
	24	If the project's implementation had been incremental …	3.78	General
	29	If there had been institutional control over the executive information system's use ...	3.39	General
	55	If the executive information system had been more important …	3.61	General
	59	If there had been organizational polices supporting the executive information system ...	3.57	General

	60	If there had been no implementation gap …	3.09	General
	62	If there had been social pressure to use the executive information system …	3.09	General
	75	If there had been organizational support on the executive information system …	4.00	General
	77	If other colleagues had had influence …	3.04	General
	87	If you had participated during the implementation project …	3.70	General
	88	If your colleagues had used the system more …	3.04	General
		Cluster Mean	**3.40**	
EIS ease of use				
	2	If the executive information system had been easier to remember…	3.43	EIS
	7	If the executive information system had been easier to learn …	3.48	EIS
	37	If you had perceived that the executive information system was less complex …	3.22	General
	41	If it had been less difficult to use the executive information system …	3.70	General
	43	If you had had more experience with the executive information system …	3.35	General
	58	If you had had more time to play with and explore the executive information system …	3.70	General
	93	If you had known how the calculations were done (having the option to check them) …	3.35	EIS
		Cluster Mean	**3.46**	
EIS design				
	3	If the executive information system screens had been designed better …	3.83	General
	13	If the executive information system had included the information you needed …	4.52	EIS
	14	If the executive information system had been more reliable …	4.35	General
	21	If you had needed less time to find the information required …	4.26	EIS
	54	If the system graphics had been better …	3.74	General
	79	If the executive information system had included "What if" functionalities …	3.57	General
	85	If the first screen had contained the most important information about all key areas …	4.00	EIS
	89	If the executive information system had had a "map-like function" in case you got lost …	3.52	EIS
		Cluster Mean	**3.97**	
EIS content and access to information				
	4	If the quality of the executive information system information had been better …	4.35	General
	15	If the executive information system had offered a greater wealth of information …	4.13	General
	16	If the executive information system had included more external information ...	4.00	General
	27	If the executive information system had had a drill-down function, enabling you to go from aggregated information to detailed data, …	4.09	EIS
	31	If the executive information system had been multidimensional in terms of functionality …	4.00	EIS
	32	If it had been easy to interpret the information in the executive information system's graphs, tables, reports, etc. …	4.43	EIS
	46	If the executive information system had been better designed to suit your tasks …	4.22	General
	53	If the executive information system could have been customized …	4.09	General
	82	If access to the executive information system director had been easier ...	3.35	General
	90	If the executive information system had been compatible with other executive information systems …	3.83	General
		Cluster Mean	**4.05**	
Importance of EIS use in the organization				
	5	If the executive group had been more innovative …	3.48	General
	6	If the use of the executive information system had been a part of the organization's culture ...	3.96	General
	20	If the project had had more visibility …	3.70	General
	42	If the organization had used the executive information system more …	3.61	General
	71	If there had been greater political pressure …	3.22	General
		Cluster Mean	**3.59**	

EIS confidence				
	8	If the executive information system had included an information confirmation mechanism …	3.09	General
	10	If there had been a problem and you could have used the executive information system to focus on the issue, disregarding the details, …	4.04	EIS
	30	If the system's infrastructures had been better …	3.70	General
	33	If the executive information system had had the same functionalities as Windows or the Internet …	3.39	EIS
	51	If the executive information system had offered clear and precise help …	3.96	EIS
		Cluster Mean	**3.63**	
Executives' involvement in EIS				
	11	If the executive information system could have been adapted to the different executive leadership styles …	3.74	General
	23	If the project's implementation process had been better…	3.78	General
	36	If resources had been available for the executive information system …	3.70	General
	40	If the designers had instilled a more favorable attitude among executives by involving them during the implementation project …	3.70	General
	47	If there had been external courses on how to use the executive information system …	3.43	General
	52	If you had participated in the executive information system's development …	3.91	General
	68	If management had been more supportive during the project's implementation …	3.91	General
	73	If there had been internal training programs for the executive information system …	3.91	General
		Cluster Mean	**3.76**	
Executives' attitudes				
	12	If you had suffered from job insecurity ...	2.57	General
	17	If you had been less defensive …	2.96	General
	25	If you had felt greater cultural affinity with the executive information system ...	3.48	General
	35	If you had trusted the executive information system …	3.87	General
	44	If you hadn't been reluctant to spend extra time learning how to use applications other than spreadsheets …	3.00	General
	48	If the use of the executive information system had been voluntary …	2.74	General
	64	If your perception of your role as an executive had been different …	3.13	General
	67	If you had been better able to innovate…	3.48	General
	86	If you had felt happier using the executive information system …	3.48	General
		Cluster Mean	**3.19**	
EIS focus				
	22	If the executive information system and the business objectives had been better linked …	4.17	General
	72	If the executive information system had contributed more to your job performance …	4.39	General
	91	If there had been conditions making it easier to access the executive information system …	3.61	General
	94	If the executive information system information had been updated more often …	3.78	General
		Cluster Mean	**3.99**	
Executives' ability to use EIS				
	26	If you had been more predisposed to using computers …	3.09	General
	34	If your ability to concentrate had been better …	3.04	General
	39	If you had been better at using the executive information system …	3.17	General
	45	If you had been more computer literate …	2.91	General
	49	If you had had a better understanding of the use of computers …	3.04	General
	57	If you had been trained on computer usage …	3.04	General
	63	If your computer skills had been better …	2.87	General
	83	If you had been less anxious about using computers …	2.74	General
		Cluster Mean	**2.99**	
Executives' proximity to EIS				
	28	If you had had support from information specialists …	3.65	General
	50	If there had been back-end support for executive information system users …	3.65	General

	56	If you had been involved in the executive information system's design …	3.96	General
	61	If you had participated in the training program …	3.48	General
	70	If the developer had been more responsive …	3.32	General
	76	If you had identified the decision-making criteria you wanted to use …	3.78	General
	92	If there had been fewer perceived risks during the project's implementation …	2.96	General
		Cluster Mean	**3.54**	
EIS accessibility				
	38	If it had been easier to know what information the executive information system contained …	3.74	EIS
	65	If the terminology used in the executive information system had been clearer …	3.65	General
	66	If it had been easier to understand the information model used …	3.83	EIS
	69	If the executive information system had been more accurate …	3.86	General
	74	If it had been easier to access the executive information system …	3.83	General
	78	If it had been easier to browse the executive information system …	3.74	General
	80	If the executive information system had been more attractive …	3.57	General
	81	If the executive information system had needed less response time …	3.83	General
	84	If the executive information system had offered greater security …	3.57	General
		Cluster Mean	**3.73**	
		Mean	**3.59**	

Table 11: Complete list of factors and clusters

In Table 12 we can see the list of clusters ordered by their average rating. I also detail said average rating and the number of factors in each cluster.

				Factors included		
Average position	**Cluster number**	**Cluster name**	**Mean rating**	**EIS**	**General**	**Total**
1	4	EIS content and access to information	4.05	3	7	10
2	9	EIS focus	3.99		4	4
3	3	EIS design	3.97	4	4	8
4	7	Executives' involvement in EIS	3.76		8	8
5	12	EIS accessibility	3.73	2	7	9
6	6	EIS confidence	3.63	3	2	5
7	5	Importance of EIS use in the organization	3.59		5	5
8	11	Executives' proximity to EIS	3.54		7	7
9	2	EIS ease of use	3.46	3	4	7
10	1	EIS organizational behavior	3.40		14	14
11	8	Executives' attitudes	3.19		9	9
12	10	Executives' ability to use EIS	2.99		8	8
		Total	3.59	15	79	94

Table 12: Clusters ordered by mean rating and the number of factors included.

The groups of factors' importance is the answer to my third research question, as we can see in more detail in section 6 below.

iii. Point map

I presented the point map above (Figure 11). This numbered point map illustrates the 94 factors as they were placed by multidimensional scaling. It illustrates the statements that were sorted together more frequently by senior executives, appearing closer to each other on the map.

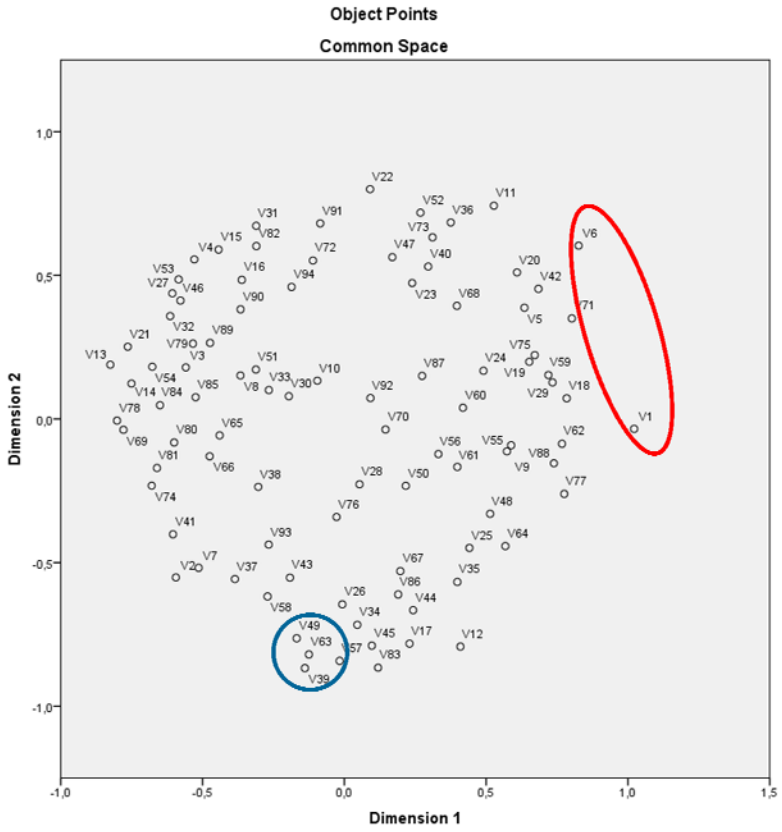


Figure 20: Interpretation of the point map

For example in Figure 20, looking at the bottom center (marked with a blue circle), we can see several factors that have been sorted in a similar manner by senior executives. For example, factor number 49, “If you had had a better understanding of the use of computers …,” number 63, “If your computer skills had been better …,” and number 39, “If you had been better at using the executive information system …,” are located in close proximity to each other.

In contrast, if we look at the far right side of the map (red ellipse) in Figure 20, statements such as number 6, “If the use of the executive information system had been a part of the organization's culture ...,” and number 1, “If other executives had influenced you to use the executive information system …,” are quite isolated from each other. This indicates that these factors were not sorted in a similar manner by senior executives.

iv. Cluster map

The twelve-solution cluster map visually portrays the same clustering relationship that appears in the point map in Figure 11 and Figure 20. Like the dots on the point map, the smaller clusters contain statements that are, from the participants’ perspective, conceptually similar. Conversely, clusters that are farther apart reflect conceptual differences. The closer the clusters are together on the map, the more similar senior executives feel those items are. The clusters located on the left side of Figure 21 below, ‘EIS design” and “EIS confidence” (marked in magenta), are good illustrations of clusters that senior executives perceive to be similar.

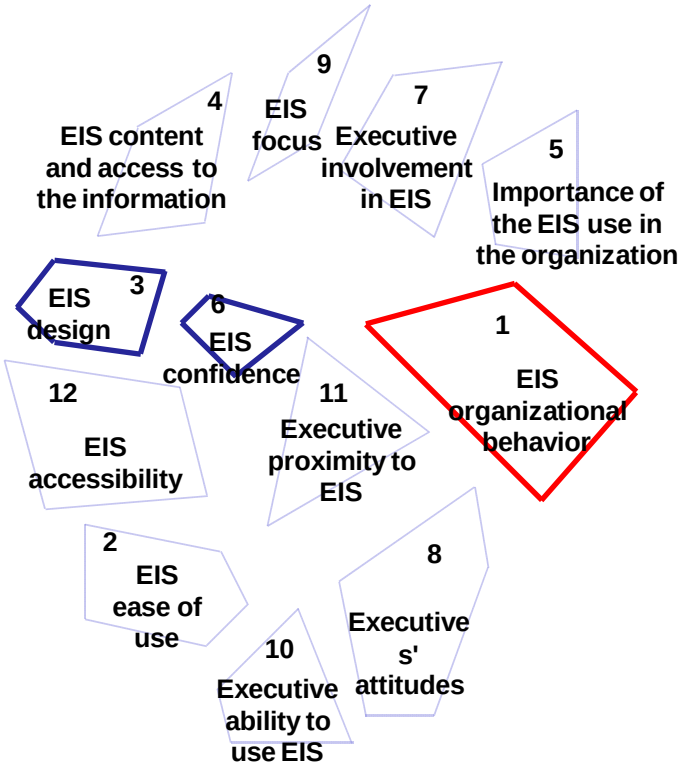


Figure 21: Interpretation of the cluster map

The size of the cluster also indicates how conceptually similar or dissimilar senior executives perceived the individual factors to be. For example, larger, more elongated clusters (see, for example, “EIS Organizational behavior highlighted in red) indicate that senior executives did not think that many of the encompassed items were conceptually similar. These include: factor 1, “If other executives had influenced you to use the executive information system …,” factor 9, “If you had been closer to sources of power …”, factor 18, “If someone had demonstrated the positive results obtained from using the executive information system …,” factor 19, “If there had been organizational pressure to use the executive information system …,” factor 24, ”If the project's implementation had been incremental …,” factor 29, “If there had been institutional control above the executive information system's use ...,” factor 55, “If the executive information system had been more important …,” factor 59, “If there had been organizational polices supporting the executive information system ...,” factor 60, “If there had been no implementation gap …,” factor 62, “If there had been social pressure to use the executive information system …,” factor 75, “If there had been organizational support on the executive information

system …," factor 77, "If other colleagues had had influence …," factor 87, "If you had participated during the implementation project …," and factor 88, "If your colleagues had used the system more …"

Conversely, the cluster labeled "EIS confidence" is relatively compact, indicating that senior executives perceived the factors within this group to be similar. These include factor 8, "If the executive information system had included an information confirmation mechanism …," factor 10, "If there had been a problem and you could have used the executive information system to focus on the issue, disregarding the details …," factor 30, "If the system's infrastructures had been better …," factor 33, "If the executive information system had had the same functionalities as Windows or the Internet …," and factor 51, "If the executive information system had offered clear and precise help …"

This is the main finding of this research and represents the response to my second research question.

v. Point rating map

The point rating map in Figure 22 below illustrates the average item ratings by respondents. The colored dots for each of the factor numbers indicate the average importance executives assigned to that item. The factors are grouped in five level scales, from 2.57 to 4.52.

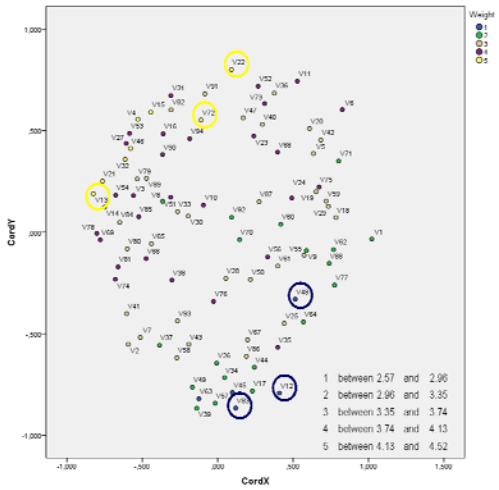


Figure 22: Interpretation of the point rating map

We should recall that I asked executives to rate statements regarding how likely they would have used the Executive Information System depending on the different conditional statements using a scale from one (much less likely) to five (much more likely). Senior executives felt that several factors were very important in terms of how they affected their EIS use. These include factor 22, “If the executive information system and the business objectives had been better linked …,” factor 72, “If the executive information system had contributed more to your job performance …,” and factor 13, “If the executive information system had included the information you needed …” Conversely, the statements they identified as not centrally important include factor 48, “If the use of the executive information system had been voluntary …,” factor 12, “If you had suffered from job insecurity ...,” and factor 83, “If you had been less anxious about using computers …”.

vi. Cluster rating map

Figure 23 below displays the same data as Figure 15 in a two-dimensional visual cluster format. Similar to the point rating map, this graphic illustrates the average ratings by senior executives in a cluster format. The legend in Figure 23 indicates that the lowest rated items (i.e., 2.99–3.20) are denoted by a single layer. Conversely, the highest rated items (i.e., 3.84–4.05) are denoted with five layers. The highest rated cluster by senior executives was “EIS content and access to information” (cluster rating average: 4.05), followed closely by “EIS focus” (3.99) and “EIS design” (3.97). Conversely, the lowest rated clusters were “Executives’ attitudes” (cluster rating average 3.19) and “Executives’ ability to use EIS” (2.99).

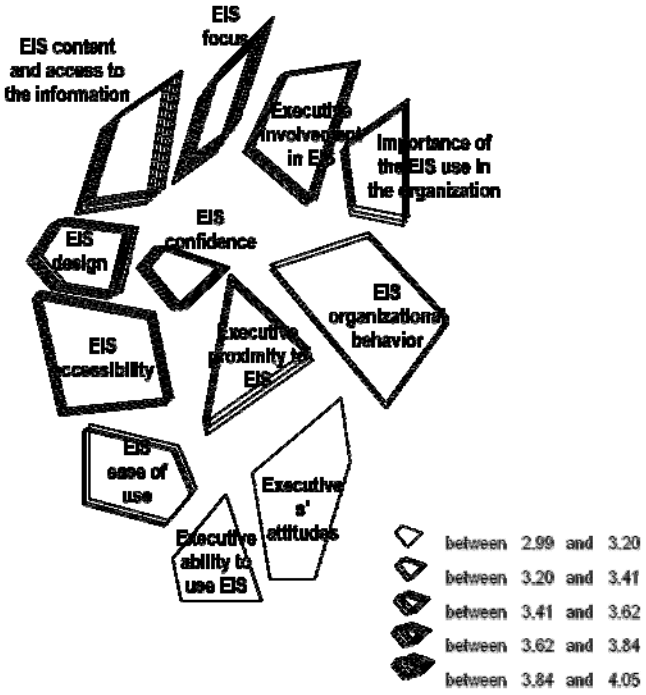


Figure 23: Interpretation of the cluster rating map

This is the answer to my third question research.

Certain groups of factors could have a greater effect on EIS use by senior executives. As we can see in the analysis of Figure 21 above, we can identify two general regions (see Figure 24):

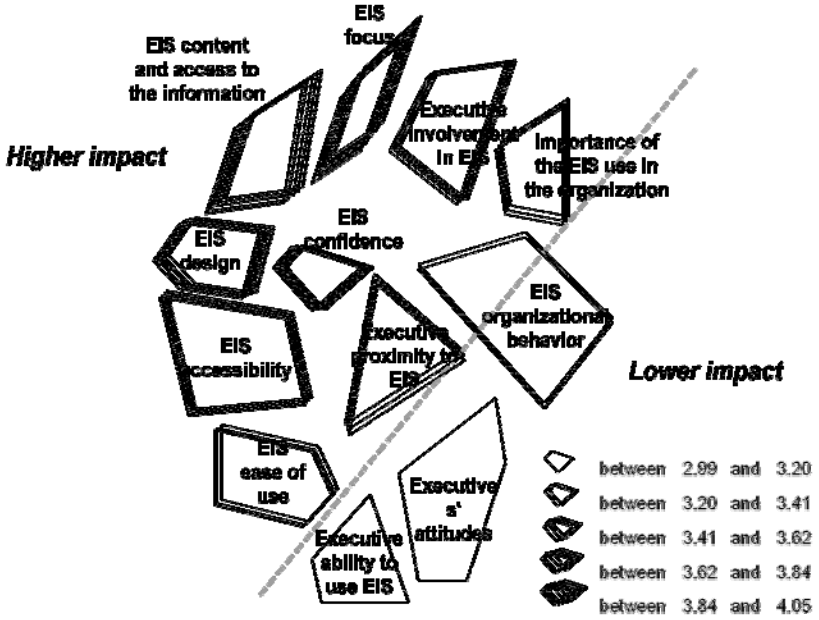


Figure 24: Higher and lower impact regions in the cluster rating map

On the upper left side we find the clusters with higher average ratings, and, on the bottom right side, the clusters with lower ratings.

As Hair et al. (2006) discuss when talking about the interpretation of the axes and Multidimensional Scaling (MDS): “Although we have no information as to what these dimensions are, we may be able to look at the relative positions of factors and infer what attributes the dimensions represent.” They add:

> MDS enables researchers to understand the similarity between objects (e.g.: factors) by asking only for above all similarity perceptions. The procedure may also assist in determining which attributes actually enter into the perceptions of similarity. Although we do not directly incorporate the attribute evaluations into the MDS procedure, we can use them in subsequent analysis to assist in interpreting the dimensions and the impacts each attribute has on the relative position of ‘the factors’ (in our case).

As we can see in Figure 25, I propose applying the following dimensions to the cluster rating map.

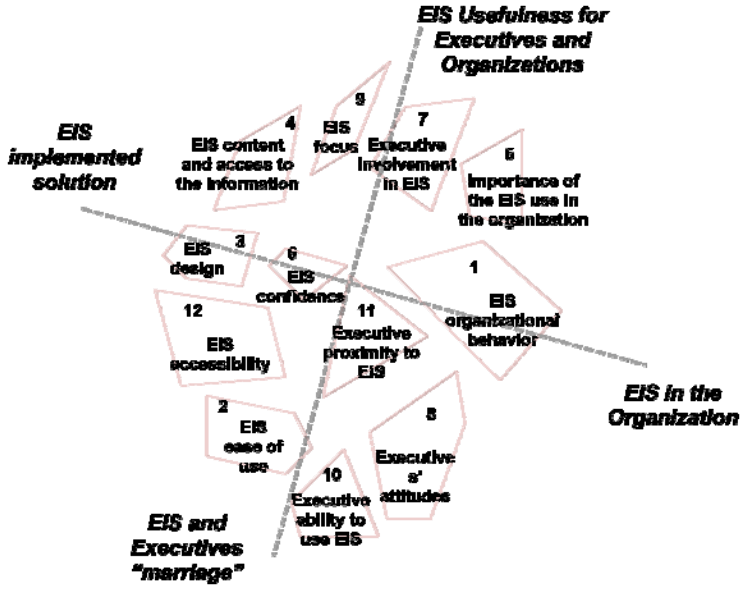


Figure 25: Dimensions of the cluster map

On the horizontal axis we find “EIS implemented solution” across from “EIS in the organization.” “EIS implemented solution” is close to the following clusters: “EIS design,” “EIS content and access to the information,” and “EIS

accessibility." As the reader can see, the three clusters depend on the concrete implementation of an EIS. "EIS in the organization" is close to the clusters: "EIS organizational behavior," and "Importance of EIS use in the organization."

In the vertical axis we find "EIS usefulness for executives and organizations" and "EIS and executive 'marriage.'"[3] "EIS usefulness for executives and organizations" is close to the clusters: "EIS focus," "Executives' involvement in EIS," and "Importance of EIS use in the organization." "EIS and executive 'marriage'" is close to: "EIS ease of use," "Executives' ability to use EIS" and "Executives' attitudes."

I believe that these findings are also useful because the X axis confirms that we cannot isolate information systems from the organizations in which they are implemented and the concrete solution that the organization was looking for. The Y axis provides another finding, namely, we cannot separate the EIS system's usefulness for senior executives and its usefulness for the organization as a whole as we can see a clear relation between them. In later sections I will defend the validity of my research. At this point, however, we can see that the findings are consistent with the literature review. As an example, Mawhinney and Lederer (1990) said that the senior executives use computers based on their contribution to the managers' job performance and depending on their level of competence. This is consistent with my findings.

vii. Differences between senior executives

In this section I aim to carry out a deeper analysis demonstrating the differences between senior executives and how they rated the different factors. Despite the sample's limitations, I found some differences between executives. This could serve to open up new opportunities for future research. In Figure 26 below, I highlight the biggest differences between how senior executives rated the groups of factors using a green ellipse to facilitate interpretation.

[3] I use the term 'marriage' to attempt to show that there is a more complex relationship between the senior executive and the EIS.

In this section, I have chosen not to use the same graphs Trochim et al. (W. M. K. Trochim et al., 2004; W. Trochim & Kane, June 2005) utilize. Instead, I adopt radar graphs as used by other researchers (Burke et al., 2005; Sutherland & Katz, 2005) because, in my opinion, they are better at revealing the differences between groups.

(1) Prior experience

As we can see in Figure 26, there are differences between senior executives that have prior experience with EIS (N=20) compared to those with no prior experience using EIS (N=3), as asked in question B1 in the survey. The correlation of this group is r = .803** (**Correlation is significant at the 0.01 level (2-tailed).

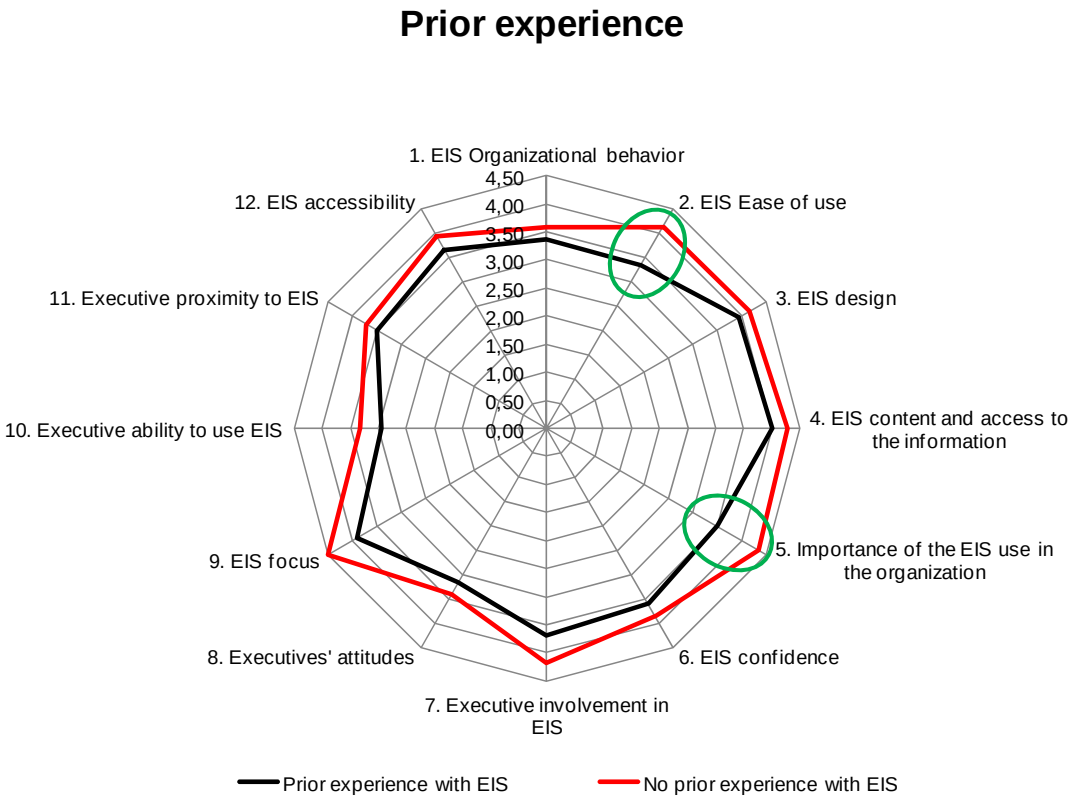


Figure 26: Rating values by senior executives that have prior experience with EIS and senior executives without it

As we can see, senior executives without prior experience using EIS rate the factors higher than those with prior experience. As such, it seems that prior experience with EIS systems might reduce the importance the different factors have.

The greatest differences occur with cluster 5, “Importance of EIS use in the organization,” and cluster 2, “EIS Ease of use.”

(2) Frequency of use

In Figure 27 below, I detail executives' ratings based on frequency of use. I divided users into groups based on how they responded to survey question B2: below average frequency of use (N=17) and above average frequency of use (N=6). The correlation in this group is r = .681* (*Correlation is significant at the 0.05 level (2-tailed).

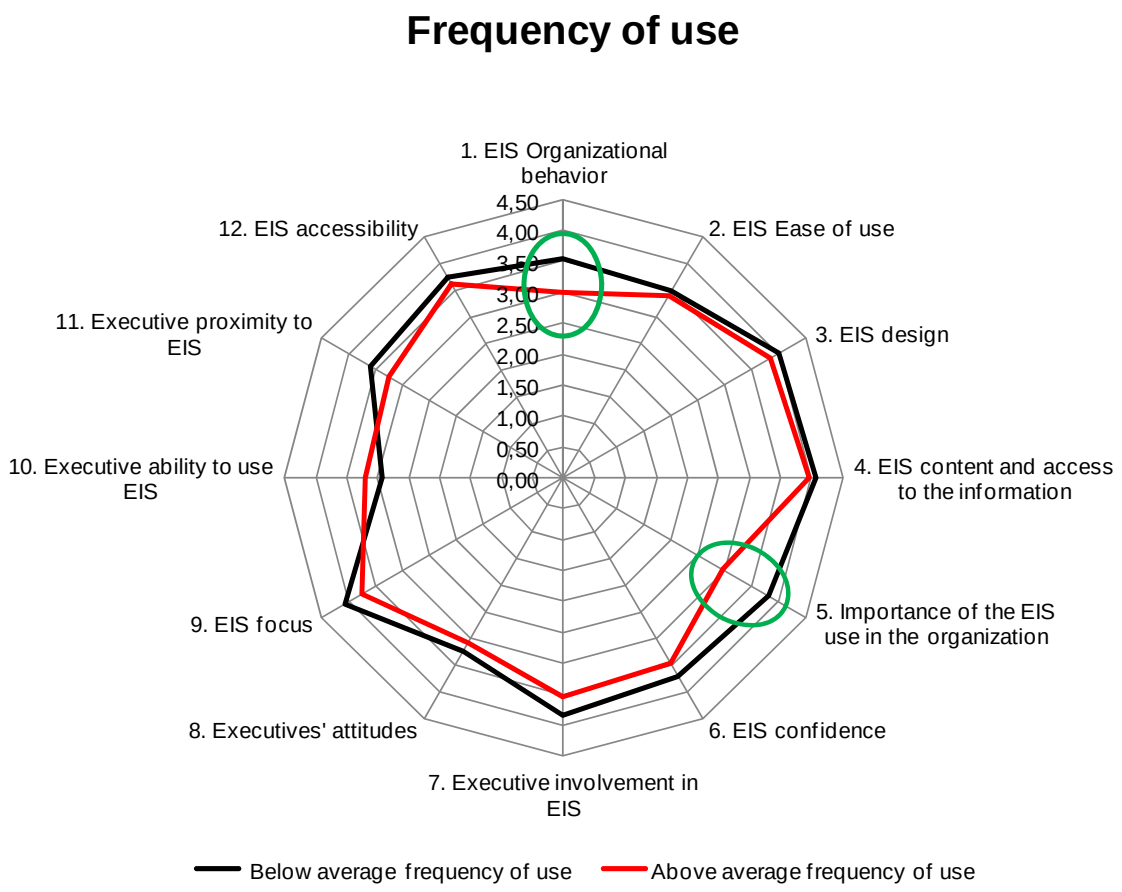


Figure 27: Rating values between senior executives based on EIS frequency of use

The biggest differences are in cluster 5, "Importance of EIS use in the organization," and cluster 1, "EIS organizational behavior."

As we can see, senior executives with the lowest frequency of use rate the factors higher.

(3) Time dedicated

In Figure 28, I detail users by time of use. There are two groups based on executives' responses to survey question B3 regarding the time they dedicate to EIS use: below average time spent (N=13) and above average time spent (N=10). The correlation in this group is r = .852** (**Correlation is significant at the 0.01 level (2-tailed):

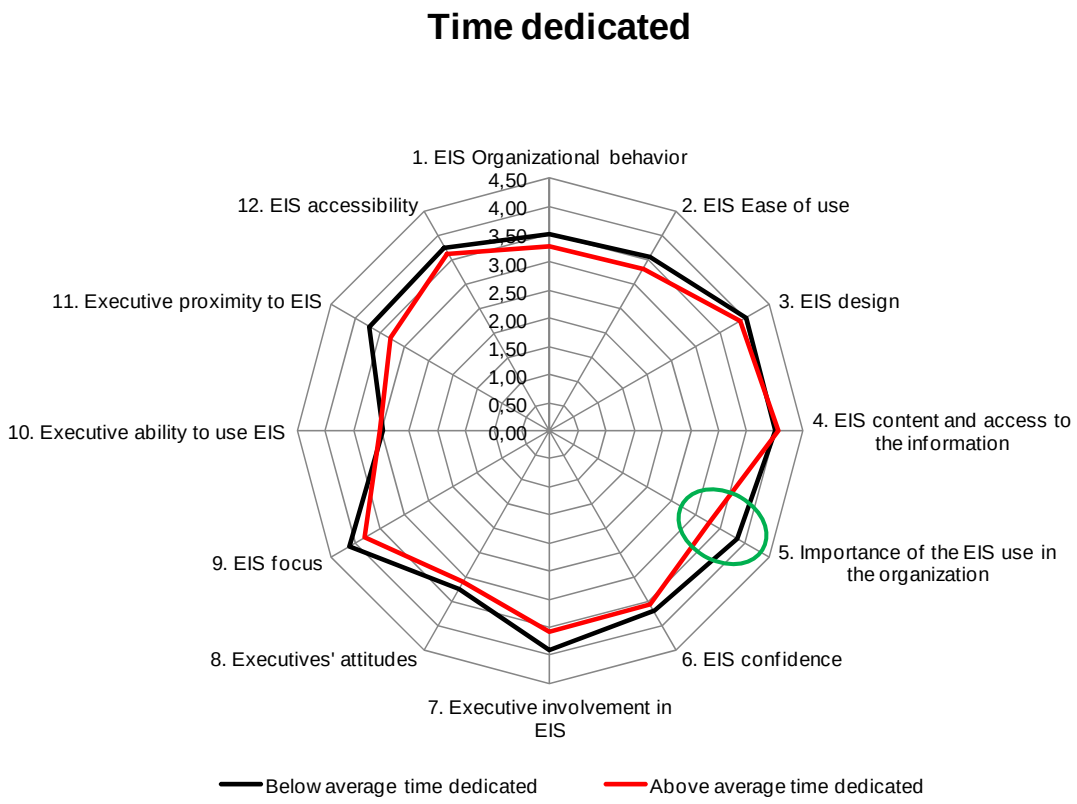


Figure 28: Rating values between senior executives based on the time spent using the EIS

The largest difference is in cluster 5, "Importance of EIS use in the organization."

As we can see, the less time spent using the EIS, the higher the rating given by executives. This is the same pattern as with frequency of use.

(4) Years of experience

Figure 29 compares users in terms of their number of years' experience using EIS. The two groups are based on their response to survey question B4: below average number of years' experience (N=14) and above average number of years using EIS (N=9). The correlation in this group is r = .827** (**Correlation is significant at the 0.01 level (2-tailed).

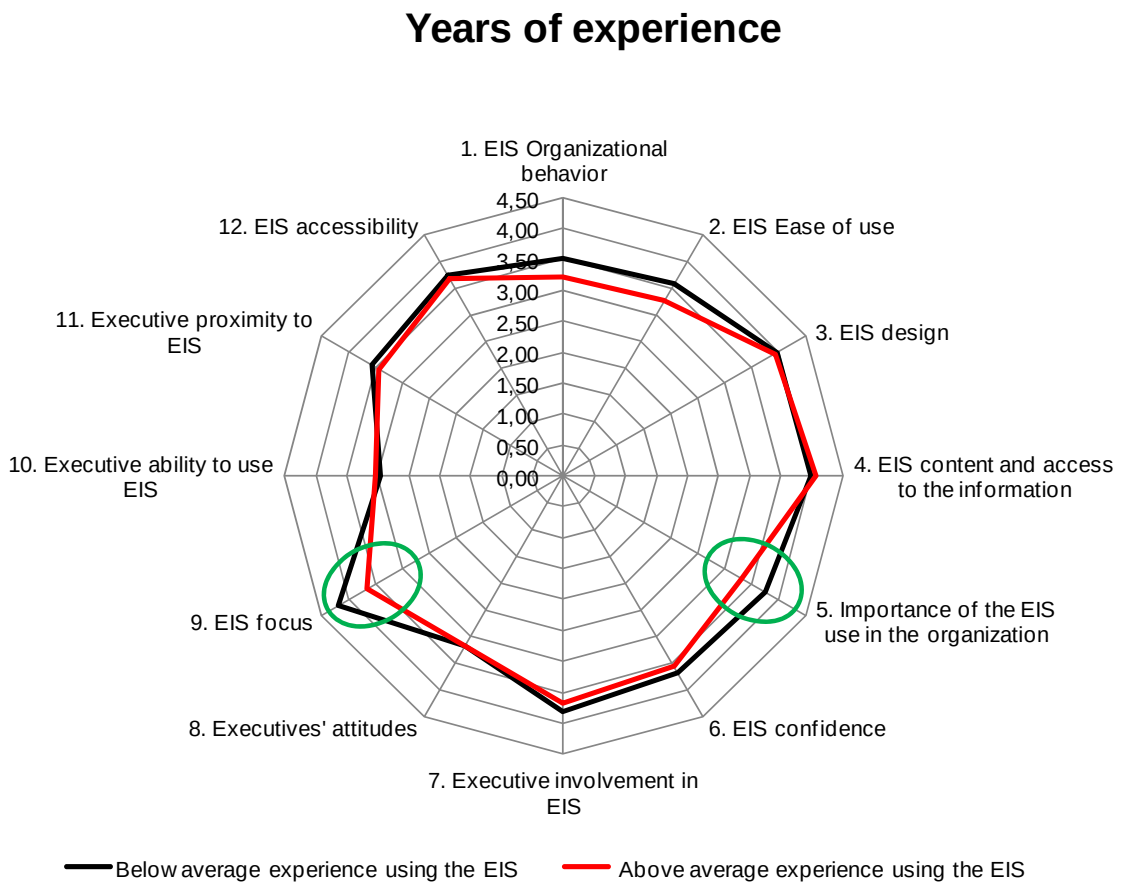


Figure 29: Rating values between senior executives based on their years of experience as EIS users

The biggest differences are in cluster 5, "Importance of EIS use in the organization," and cluster 9, "EIS focus."

Once more, the lower the number of years of experience using EIS, the higher the ratings.

(5) Percentage of EIS system used

Figure 30 details ratings from two groups of users based on survey question B5 in terms of the percentage of the EIS system used: below average percentage used (N=11) and above average percentage used (N=12). The correlation in this group is r = .926** (**Correlation is significant at the 0.01 level (2-tailed).

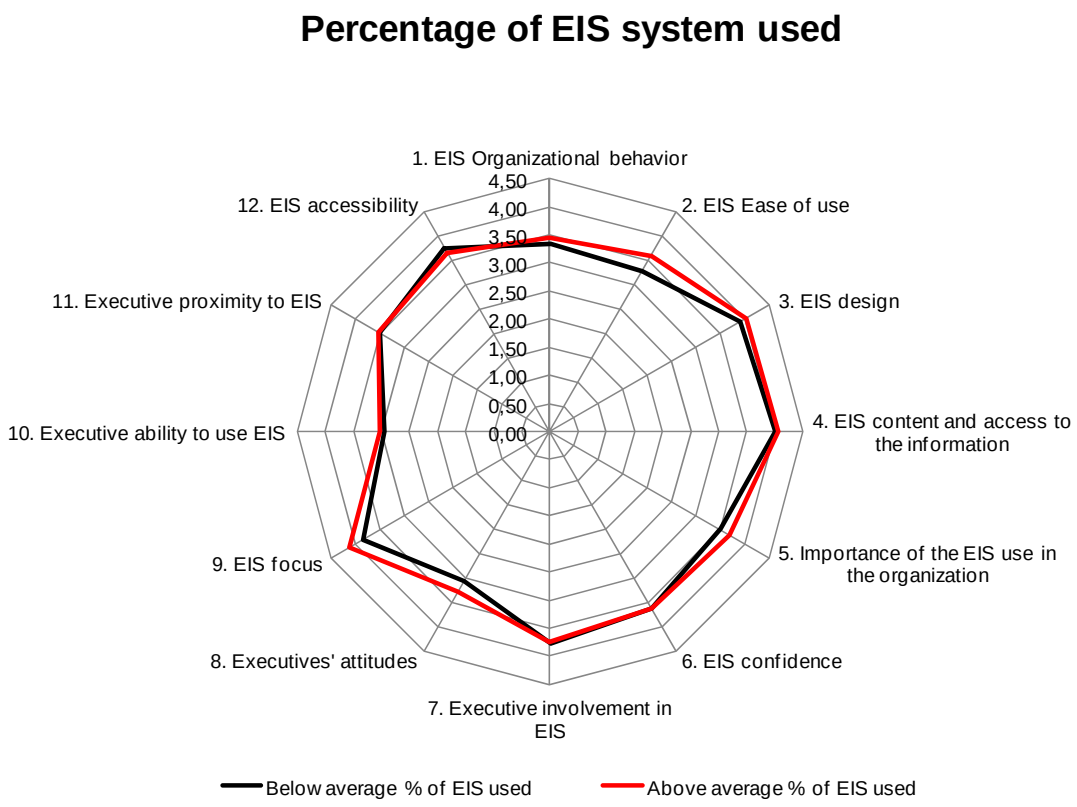


Figure 30: Rating values between senior executives based on the percentage of the EIS system used

In this case, the higher the percentage of the EIS system used, the higher the ratings. However, there is no significant difference between group ratings of the clusters.

(6) Executives' self-evaluation as users

Figure 31 details ratings by two groups based on their responses to survey question B6 regarding their self-evaluations as EIS users: high self-evaluation as a user (N=12) and low self-evaluation as a user (N=11). The correlation in this group is r = .917** (**Correlation is significant at the 0.01 level (2-tailed).

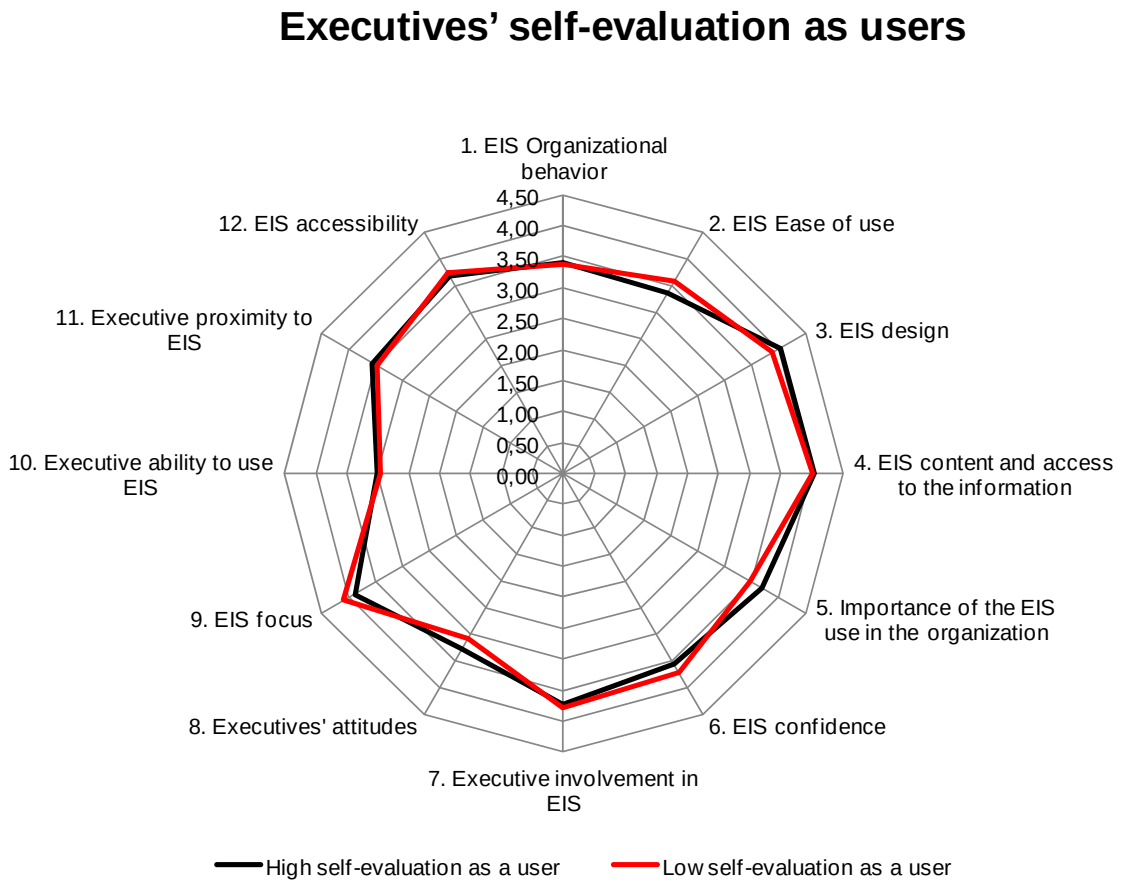


Figure 31: Rating values by executives' self-evaluations

As we can see, ratings are essentially the same between executives who evaluate themselves as advanced users and low-level users.

(7) Satisfaction with EIS

Figure 32 describes executives' ratings based on their response to survey question B7 regarding their satisfaction with the EIS system used: below average satisfaction levels (N=10) and above average satisfaction levels (N=13). The correlation in this group is r = .922** (**Correlation is significant at the 0.01 level (2-tailed).

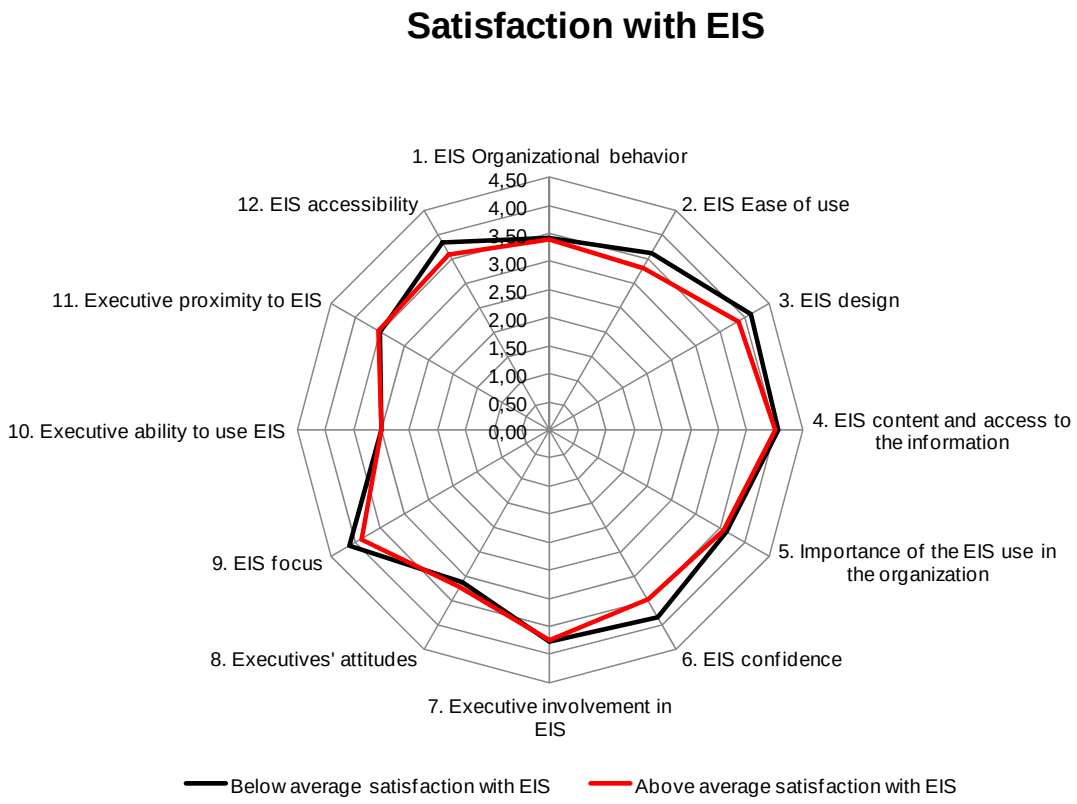


Figure 32: Rating values by executives' satisfaction with their EIS

As we can see, executives with below average levels of satisfaction rate the factors slightly higher.

(8) Job position

In Figure 33 I compare ratings by General Managers (N=5) and executives holding other managerial positions (N=18). I divided executives into these groups based on their responses to survey question C1. The correlation in this group is r = .881** (**Correlation is significant at the 0.01 level (2-tailed).

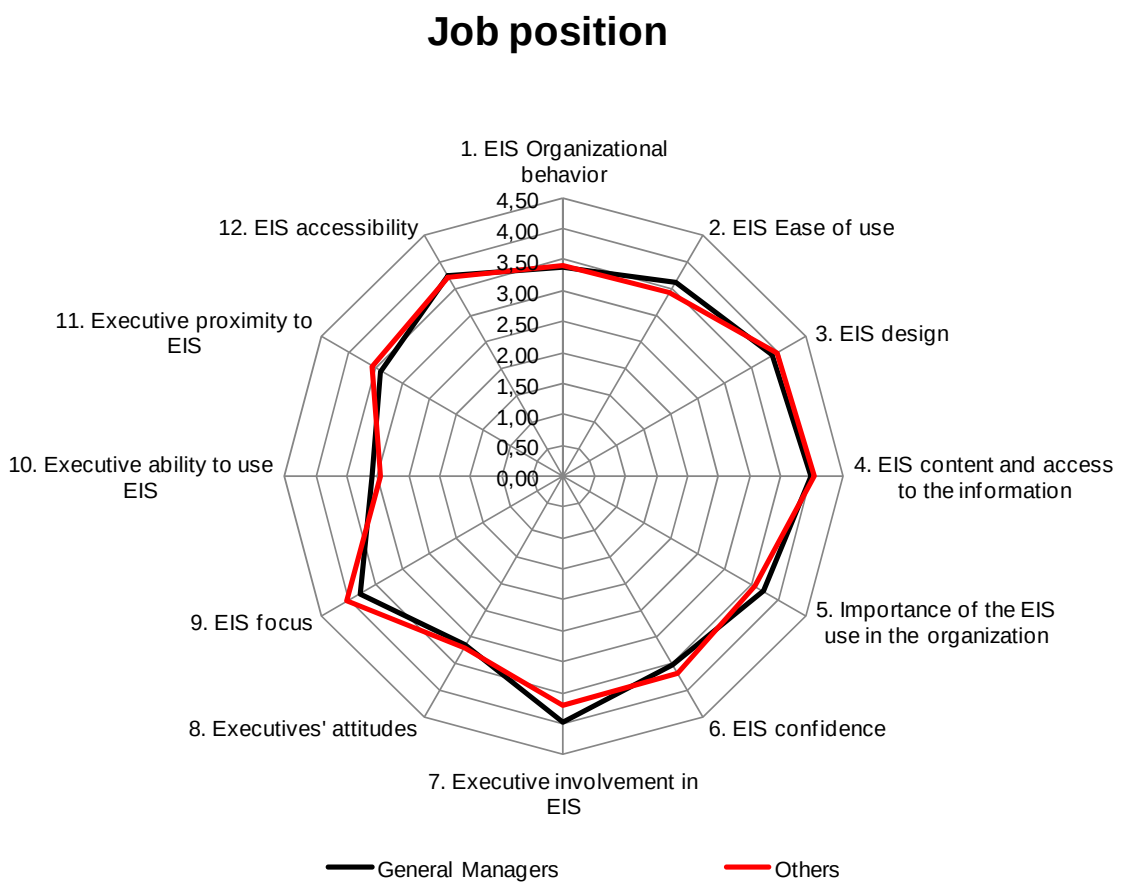


Figure 33: Rating values by job position

As we can see, there is no significant difference between General Managers and other senior executives.

(9) Executives' age

Figure 34 compares ratings form younger senior executives, under the age of 45 (N=19) and older senior executives, over 45 (N=4). These groups were created based on survey question C2. The correlation in this group is r = .892** (**Correlation is significant at the 0.01 level (2-tailed).

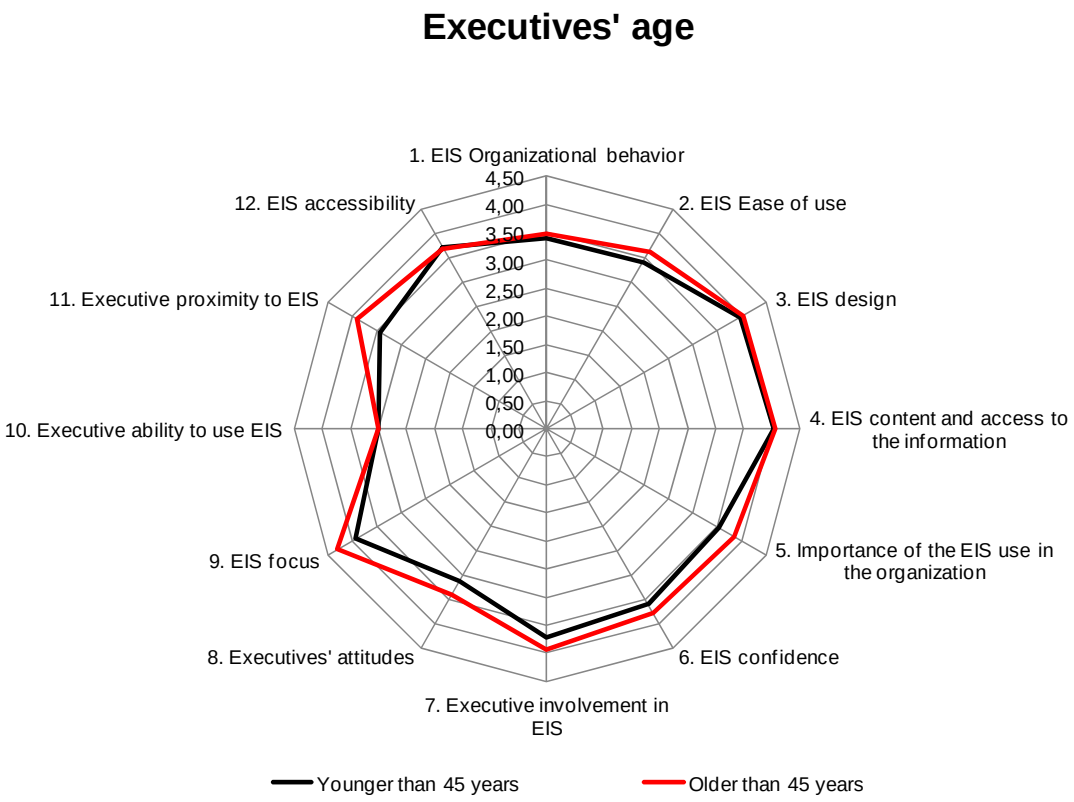


Figure 34: Rating values based on the senior executives' ages

As we can see, older senior executives rate the factors higher than younger executives.

(10) Gender

Figure 35 details ratings based on senior executives' gender: men (N=19) and women (N=4). I defined these groups based on executives' responses to survey question C3. The correlation in this group is r = .722** (**Correlation is significant at the 0.01 level (2-tailed).

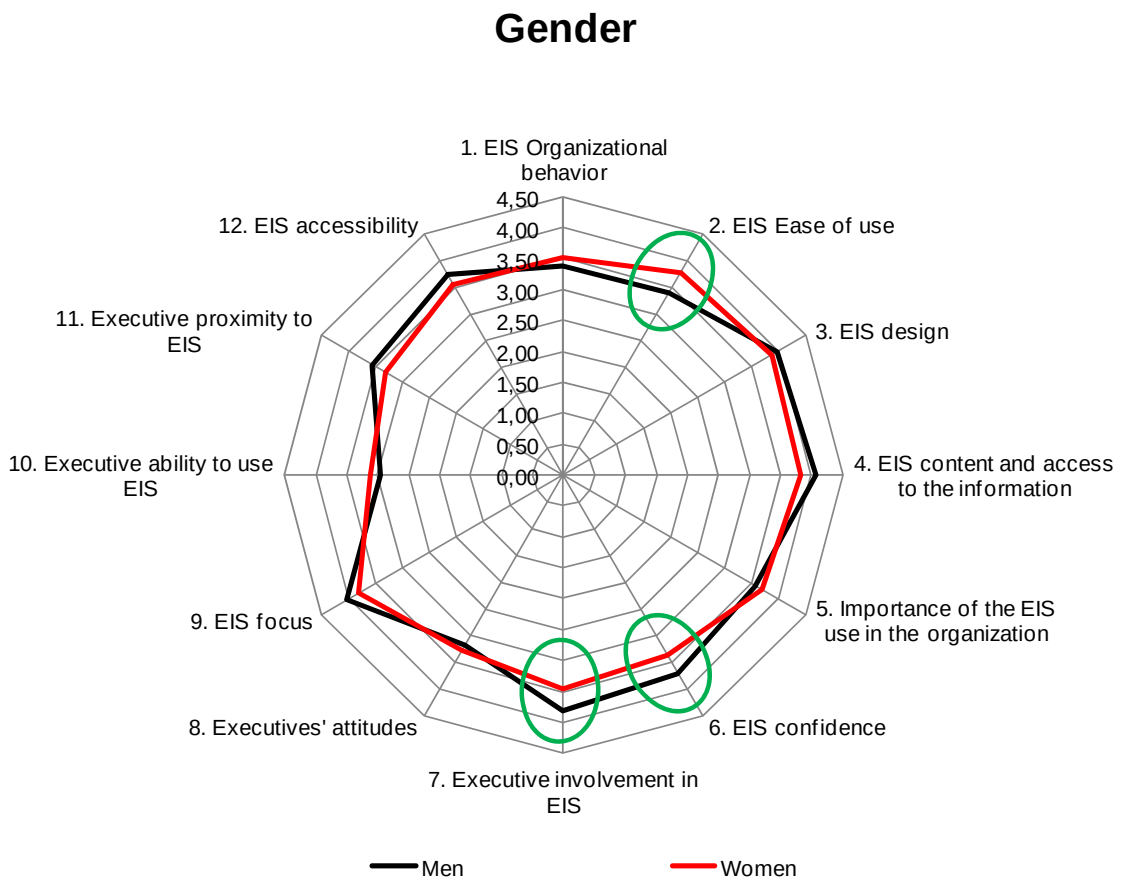


Figure 35: Rating values based on senior executives' gender

The biggest differences signaled are in cluster 2, "EIS ease of use," cluster 6, "EIS confidence" and cluster 7, "Executives' involvement in EIS.

(11) Executives' work experience

Figure 36 compares ratings form senior executives who have less work experience (N=9) and senior executives with more experience (N=14). These groups are based on how they responded to survey question C7. The correlation in this group is r = .927** (**Correlation is significant at the 0.01 level (2-tailed).

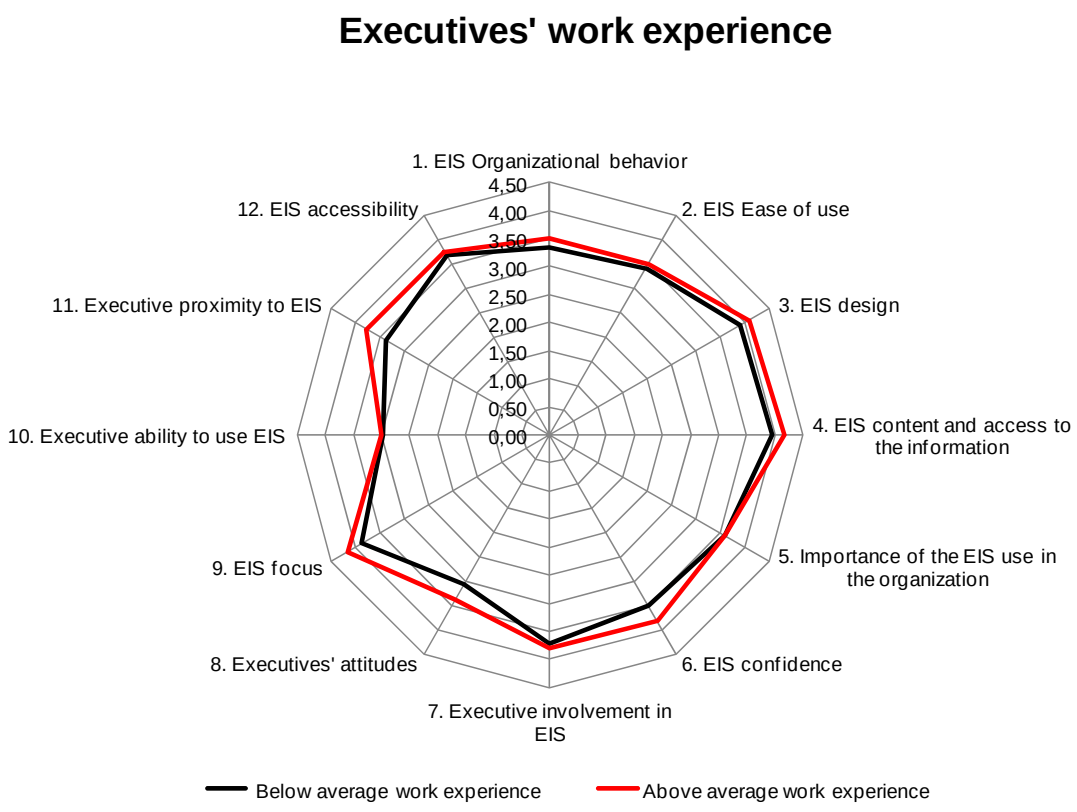


Figure 36: Rating values based on work experience

As we can see, senior executives with more experience rate the factors higher than senior executives with less work experience.

(12) Seniority

In Figure 37, I detail ratings form senior executives who have worked less time at their current firm (N=8) compared to senior executives who have worked more time at their current firm (N=15). I divided executives into these groups based on their responses to survey question C8. The correlation in this group is r = .913** (**Correlation is significant at the 0.01 level (2-tailed).

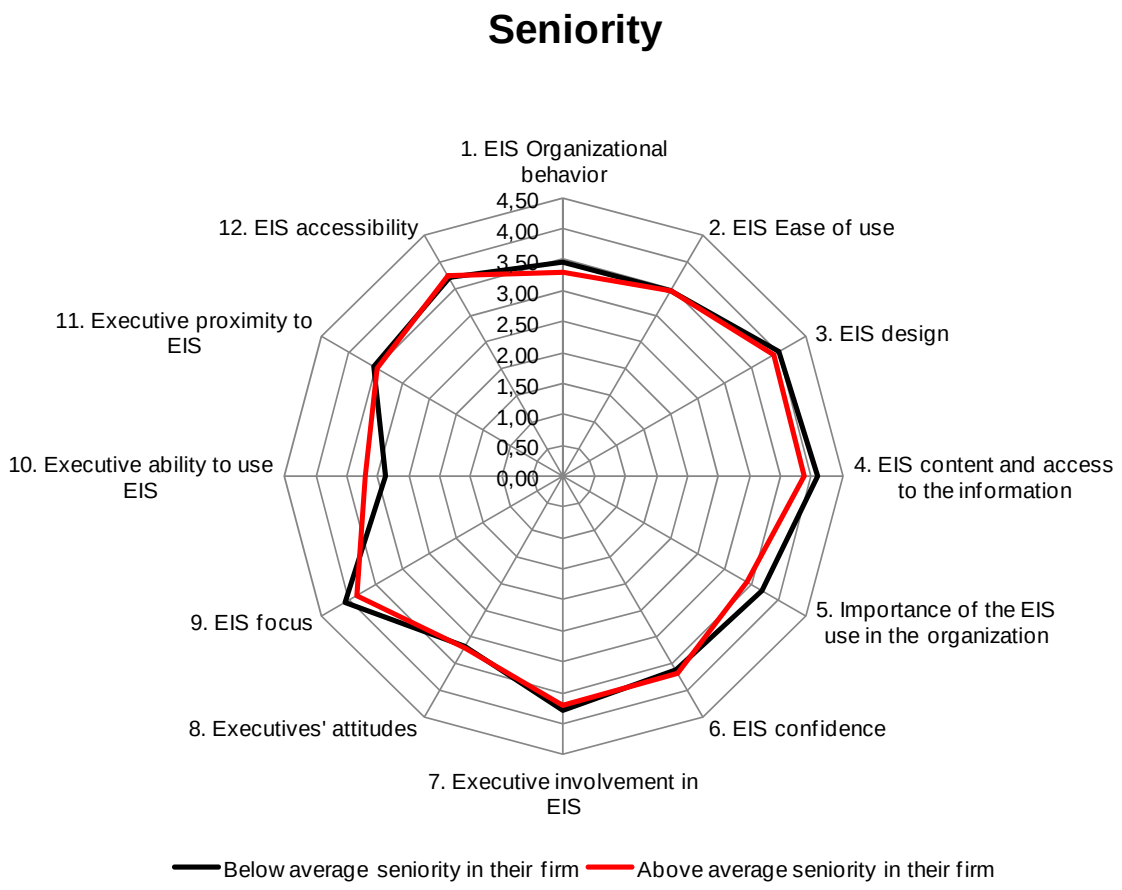


Figure 37: Rating values by executives' seniority

As we can see, there is no remarkable difference.

I summarize the differences between groups and how each rated the clusters of factors in Table 13 below.

Lower ratings	Higher ratings
Prior experience with EIS	No prior experience with EIS
Above average frequency of use	Below average frequency of use
Above average time of use	Below average time of use
Above average experience using the EIS	Below average experience using the EIS
Above average satisfaction with EIS	Below average satisfaction with EIS
Below average % of EIS used	Above average % of EIS used
Low self-evaluation as a user	High self-evaluation as a user
General Manager	Other managerial positions
Younger than 45	Older than 45
Women	Men
Below average work experience	Above average work experience
Above average seniority in their firm	Below average seniority in their firm

Table 13: Lower and higher ratings by groups

In a detailed analysis of how different groups of senior executives rate the factors, the highest differences can be seen between senior executives with no prior experience in EIS use and those who have prior experience. Those without prior experience consider the factor, “Importance of EIS use in the organization,” as the second most important group of factors compared to the group average which rates this cluster as the fifth most important. Conversely, executives with above average frequency of use consider that the same cluster of factors is the least important, relegating it to the twelfth position.

I cannot end this section without discussing the validity of my findings. As Jackson and Trochim (2002) indicate:

> Qualitative data pose an interesting obstacle to validity. If we don’t know anything about the subject, we cannot capture the meaning effectively—conversely, if we do know a lot about the subject, our own biases might interfere (Miles & Huberman, 1994). Concept mapping helps us to solve this tension somewhat by combining statistical analysis and human judgment. The degree to which theory guides the concept mapping analysis is introduced through different choices about whom to include as decision makers and as a researchers during the analysis. The more respondents are used at each stage of the analysis, the greater the

> resulting map represents their collective understanding. Because concepts are social constructions, there is really no way to establish a standard by which to judge the degree of error (Krippendorff, 2004). The main strength that concept mapping offers to validity is that by using multidimensional scaling and cluster analysis to represent the similarity judgments of multiple coders, it allows meaning and relationships to emerge by aggregating the “biases” or “constructions” of many.

My main intention here was to group the factors that senior executives take into account when they use an EIS. To do this, I started with an empirical research study. I realized that the factors these executives mentioned were related to the implemented EIS solution, but there was no relationship with factors mentioned in the literature. As such, I decided to broaden the scope of my research by adding some factors mentioned in the literature focused on TAM and the relationship between executives and their use of computers and applications. To do this I analyzed 125 papers to select the factors.

Though the goodness of fit is considered ‘poor’, the clusters presented are explicit, and the axes are clear. In addition, the clusters are consistent with the literature review presented in the conceptual framework.

6. Reflection and discussion

In this last section, I set out to explore the answers to my research questions in addition to other findings, scientific contributions, methodological contributions, and future lines of research.

i. Answers to research questions:

I analyzed results in the previous section but I now formally present the answers to my research questions.

The first research question was:

Is additional qualitative research needed to find more valuable information about the factors?

I can confirm that more qualitative research is necessary to uncover more valuable information about the factors (as presented in section 5.i. above). I extracted 15 factors from the initial interviews and 79 factors from the literature review. However, senior executives rated the 15 initial factors taken from interviews higher than the rest of factors. This reveals that, should the situations based on those 15 factors arise, they would more likely increase their use of EIS compared to the other factors. At no time did the executives know that the factors came from interviews with other senior executives. I tested this with senior executives and EIS specifically. As such, it should also be tested with other IT artifacts and other users.

This was one of the motivations behind my research because there are many differences between different kinds of ITs and between different kinds of users. Scholars should carry out qualitative research to identify the particularities of the users and the systems and their relationship. This is one the main criticisms of TAM. Though we can measure an information system's perceived usefulness and perceived ease of use, we need to know what the antecedents are in order

to manage the project better. This first question thus attempts to answer a well-known limitation of TAM, as some researchers have pointed out, namely, the necessity to find the external factors that can affect usage (Hong et al., 2001; Venkatesh & Davis, 1996; Venkatesh & Davis, 2000; Venkatesh, 2000; Venkatesh et al., 2003; Yousafzai, Foxall, & Pallister, 2007a; Yousafzai, Foxall, & Pallister, 2007b).

In terms of generalizing this research and results, numerous studies attempt to confirm general theories. TAM is an example of this. Though findings are very helpful, TAM has been tested with different kinds of information systems and different users. Also, there are many differences between information systems and their users; as such, general theories are sometimes simply too general. When we try to apply them to concrete situations, they add little value in terms of the concrete project or little help is available for practitioners when they would like to use them.

The second research question was:

What groups of factors do senior executives believe affect their use of executive information systems?

Examining the results of the survey with MDS and cluster analysis, I have presented twelve groups of factors in section 5.ii. These groups are:

1. EIS content and access to information
2. EIS focus
3. EIS design
4. Executives' involvement in EIS
5. EIS accessibility
6. EIS confidence
7. Importance of EIS use in the organization
8. Executives' proximity to EIS
9. EIS ease of use
10. EIS organizational behavior

11. Executives' attitudes
12. Executives' ability to use EIS

These groups of factors are more detailed than the clusters proposed by Pijpers, Bemelmans, Heemstra and van Montfort (2001) and Ikart (2005). The first authors proposed an aggregation based on: individual characteristics, organizational characteristics, task-related characteristics, and IT resource characteristics. The second author proposed another aggregation based on: social factors, habits and facilitating conditions. Some of my groups of factors could be included in these aggregations, but I believe that the level of detail in my research is greater and more specific.

I have also tried to propose a theory with the limitations presented in previous sections. I believe that this theory could help practitioners involved in one kind of information system project with one kind of user to be more specific: EIS projects and senior executives, finding a reduced number of factor groups. This is also a generalization. Not all EIS systems are the same, and there are also differences between senior executives. However, the factors presented are a reference with which to further explore a concrete situation.

The third research question was:

How important are these groups of factors for senior executives?

In table 14 below I detail the list of clusters ordered by their average ranking in terms of importance and the average score received. This represents the response to my third question research.

Average position	Cluster name	Average rating
1	EIS content and access to information	4.05
2	EIS focus	3.99
3	EIS design	3.97
4	Executives' involvement in EIS	3.76
5	EIS accessibility	3.73
6	EIS confidence	3.63
7	Importance of EIS use in the organization	3.59
8	Executives' proximity to EIS	3.54
9	EIS ease of use	3.46
10	EIS organizational behavior	3.40
11	Executives' attitudes	3.19
12	Executives' ability to use EIS	2.99
	Total	3.59

Table 14 Clusters ordered by average rating

As can be gathered, there is not a lot of difference in terms of the factors' importance. In my opinion this is due to the complexity of this kind of system as well as its users. The bad news for practitioners, then, is that they shouldn't omit any group of factors to ensure the success of their EIS project because the different factors' rating average is very similar. I would also underscore that the most highly rated factors are the factors related with the EIS solution itself.

ii. Other findings

Another finding worth highlighting is related to the analysis of the cluster map dimensions. The 'vertical' dimension contrasts "EIS usefulness for executives and organization" with "EIS and executive 'marriage.'" On one side, then, we have EIS usefulness and, on the other, the relationship between the information system and its users. This could be interpreted as a trade-off between utility and effort, and we can easily find examples in our own lives. Some studies have attempted to explain the use of an IT artifact as a function of its perceived cost and benefits, for example, Mawhinney and Lederer (1990) when discussing personal computer utilization by managers. I believe that relationships between senior executives and the executive information systems they use are more complex than their level of competence with respect to that kind of system. This

is because the relationship between them depends on: the executives' ability to use EIS, executives' attitudes, EIS ease of use, EIS accessibility and executives' proximity to EIS, all the clusters that have led me to call this relationship a 'marriage.'

Based on my findings, when senior executives think about usefulness, they think about the EIS' usefulness for them but also for the organization, as presented in the section analyzing the dimensions of the cluster rating map ("EIS usefulness for executives and organizations"). We can affirm that the proximity between the clusters represents the value for the organization and for the executives. As such, it seems that the value for them is close. This point should be largely discussed because regrettably, managers' interests are not aligned at times with those of their organizations.

Another additional finding is that senior executives think that the factors that would increase their use of an EIS are more related to the EIS itself. Specifically, this refers to the usefulness of the EIS for them and for the organization, and the relationship between senior executives and the EIS. This finding reveals the importance the IT artifact has and also underscores that we can't isolate the IT artifact to try to understand its use; nor can we isolate our research from the organizational point of view.

Finally, despite the limitations stemming from the number of subjects studied, I found some interesting differences between groups as discussed in section 5.vii. This part of my research should be further explored with a higher number of senior executives.

iii. Scientific contributions

The main scientific contribution of this thesis is having completed one small part of research on one of the most tested and studied theories in IT: TAM. This thesis demonstrates the importance that qualitative research has in terms of

studying one type of IT and one type of user before carrying out quantitative research.

The second most important contribution is presenting a model to understand how senior executives group together the factors that they think could affect their use of EIS and also the importance those groups of factors have. In this respect, I have presented a general model for this kind of user and IT.

Another scientific contribution is presenting a theory that shows how senior executives group the factors affecting their use of EIS to contrast with the two theories proposed by Pijpers et al. (2001) and Ikart (2005), factors these authors don't specifically test.

iv. Methodological contributions

It is not easy to do research with senior executives, but, as this thesis shows, the Concept Mapping methodology can help facilitate this process. I adapted this methodology to ensure success. In hindsight, after completing this study, I do feel that 94 factors are a high number to sort, especially for senior executives. Some of these executives commented on this difficulty specifically. In future research I would probably try to reduce the number of factors if feasible.

The second methodological contribution is determining that by increasing the number of initial interviews in future research I would probably increase the model's internal consistency.

Now, we can conclude that Concept Mapping is a methodology we should take into account with senior executives whenever applicable.

Furthermore, I also think that this methodology applied in one concrete situation, with one system and one group of users working in a single company

would provide additional findings that could help IT managers better assign the resources they manage.

I have also used radar graphs instead of the line graphs typically used by most researchers. I did so to present the differences between groups of users. In my opinion, we can see the differences between all the clusters better by using these types of graphs.

v. Future lines of research

I would encourage other researchers to study the importance of previous qualitative studies applied to other kinds of users and systems. This would serve to confirm others' hypotheses (Yousafzai, Foxall, & Pallister, 2007a; Yousafzai, Foxall, & Pallister, 2007b) about the need to do more qualitative studies to better understand the factors that may affect users and IT solutions.

Another possible line of research is exploring if different factors affect different kinds of IT systems or different kinds of users. Similarly, worth exploring would be if one kind of user considers the same factors as important for different kinds of IT applications, in this case, isolating that specific system.

These two possible lines of research should also evaluate the importance of every factor and group of factors.

I have found new opportunities for research through this thesis, especially in the analysis of the differences between senior executives and how they rate the groups of factors based on if they have prior experience or not with EIS systems, by the frequency of their EIS use, by the time of their EIS use, by experience in EIS use, by the % of EIS used, by their own self-evaluations as EIS users, by gender, by work experience, and user seniority.

Another opportunity for research is to use concept maps to develop implementation projects and compare the success of those projects with other projects which didn't use the concept map as a tool to define the project itself. In

future research I believe that I should reduce the number of cards to sort. I need to balance between reducing the number and reducing the detail or the scope of analysis. Based on this study, I believe that Concept Mapping is useful to do research with senior executives and IT solutions. Reducing the number of factors would probably help increase the map's internal coherence.

We know that all the factors affect senior executives' use of EIS. But, due to the high number of factors we didn't relate with perceived usefulness (PU) and perceived ease of use (PEOU), researchers interested in TAM could carry out further studies to clearly comprehend what senior executives understand as PU and PEOU.

My last reflection is for EIS software vendors. As we've seen, senior executives only use 39% of the EIS' functionalities, a low percentage. It seems that software vendors need to give serious consideration to this low percentage. They should analyze if they are developing the functionalities that senior managers need or, contrarily, if they should invest more in methodologies to increase the senior executives' level of satisfaction with EIS. A 5.3 on a 0 to 10 scale is not a good mark.

To conclude, I would like to end this thesis by citing Louis Pasteur. I came across this quote when I began my research:

> To the individual who devotes his or her life to science, nothing can give more happiness than when results immediately find practical application. There are *not* two sciences. There is science and the application of science, and these two are linked as the fruit is to the tree.

This is, I believe, my modest contribution to offering senior executives EIS projects which understand them and their needs more and better while also providing researchers new opportunities for research.

7. References

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology - a replication. Mis Quarterly, 16(2), 227-247.

Agarwal, R., & Prasad, J. (1998a). The antecedents and consequents of user perceptions in information technology adoption. *Decision Support Systems, 22*(1), 15.

Agarwal, R., & Prasad, J. (1998b). A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information Systems Research, 9*(2), 204-215.

Anónimo. (1995). Making EIS work. *International Journal of Health Care Quality Assurance, 8*(4), 7-8.

Arnott, D., & Pervan, G. (2005). A critical analysis of decision support systems research. *Journal of Information Technology (Palgrave Macmillan), 20*(2), 67-87.

Ault, J. T., & Gleason, J. M. (1998). Expectations and patterns of use of emerging and existing information technologies by federal government decision-makers. *Effective Utilization and Management of Emerging Information Technologies,* , 687-691.

Bailey, J. E., & Pearson, S. W. (1983). Development of a tool for measuring and analyzing computer user satisfaction. *Management Science, 29*(5), 530-545.

Bajwa, D. S., Rai, A., & Brennan, I. (1998). Key antecedents of executive information system success: A path analytic approach. *Decision Support Systems, 22*(1), 31-43.

Bartholomew, D. J., Steele, F., Moustaki, I., & Galbraith, J. I. (2008). In Chapman &Hall/CRC (Ed.), *Analysis of multivariate social science data* (2nd Edition ed.). Boca Raton, FL:

Benbasat, I., & Barki, H. (2007). Quo vadis, TAM? *Journal of the Association for Information Systems, 8*(4), 211-218.

Bigné, J. E., Aldas-Manzano, J., Kuster, I., & Vila, N. (2002). The concept mapping approach in marketing: An application in the travel agencies sector. *Qualitative Market Research: An International Journal, 5*, 87-95(9).

Brady, R. H. (1967). Computers in top-level decision making. *Harvard Business Review, 45*(4), 67-76.

Buchanan, L., & O'Connell, A. (2006). A brief history of decision making. *Harvard Business Review, 84*(1), 32-+.

Burkan, W. (1988). Making executive information systems work. *DSS-88 Transactions - Eighth International Conference on Decision Support Systems,* Boston, Massachusetts. pp. 121-136.

Burke, J. G., O'Campo, P., Peak, G. L., Gielen, A. C., McDonnell, K. A., & Trochim, W. M. K. (2005). An introduction to concept mapping as a participatory public health research method. *Qualitative Health Research, 15*(10), 1392-1410.

Burton-Jones, A., & Hubona, G. S. (2006). The mediation of external variables in the technology acceptance model. *Information & Management, 43*(6), 706-717.

Cano Giner, J. L. (2011). Use of computers and applications by senior executives. *Journal of Industrial Engineering and Management, 4*(2), 326-326-338.

Cano, J. L., Fernández Alarcon, V., & Díaz Boladeras, M. (2008). Factors that affect perceived usefulness and perceived ease of use of executive information systems among executives. *International Conference and Doctoral Consortium "Organization Development and Change" ISEOR and Academy of Management,* Lyon, Francia. *, 1.* pp. 321-321-331.

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy - development of a measure and initial test. *Mis Quarterly, 19*(2), 189-211.

Crockett, F. (1992). Revitalizing executive information systems. *Sloan Management Review, 23*(4), 39-47.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Mis Quarterly, 13*(3), 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer-technology - a comparison of 2 theoretical-models. *Management Science, 35*(8), 982-1003.

Davis, F. D., & Venkatesh, V. (1996). A critical assessment of potential measurement biases in the technology acceptance model: Three

experiments. *International Journal of Human-Computer Studies, 45*(1), 19-45.

Davis, F. D., & Venkatesh, V. (2004). Toward preprototype user acceptance testing of new information systems: Implications for software project management. *IEEE Transactions on Engineering Management, 51*(1), 31-46.

Davis, S., & Wiedenbeck, S. (2001). The mediating effects of intrinsic motivation, ease of use and usefulness perceptions on performance in first-time and subsequent computer users. *Interacting with Computers, 13*(5), 549-580.

Drucker, P. F. (1998, 08/24). The next information revolution., 46.

Elbeltagi, I., McBride, N., & Hardaker, G. (2005). Evaluating the factors affecting DSS usage by senior managers in local authorities in egypt. *Journal of Global Information Management, 13*(2), 42-65.

Fitzgerald, G. (1992). Executive information systems and their development in the U.K.: A research study. *International Information Systems, 1*(2), 1–35.

Friend, D. (1986). Executive information systems: Successes, failures, insights, and misconceptions. *DSS 86 Transactions,* , 35-40.

Gefen, D., Karahanna, E., & Straub, D. W. (2003a). Inexperience and experience with online stores: The importance of TAM and trust. *IEEE Transactions on Engineering Management, 50*(3), 307-321.

Gefen, D., Karahanna, E., & Straub, D. W. (2003b). Trust and TAM in online shopping: An integrated model. *Mis Quarterly, 27*(1), 51-90.

Gefen, D., & Keil, M. (1998). The impact of developer responsiveness on perceptions of usefulness and ease of use: An extension of the technology acceptance model. *Data Base for Advances in Information Systems, 29*(2), 35-49.

Gefen, D., & Straub, D. W. (1997). Gender differences in the perception and use of E-mail: An extension to the technology acceptance model. *Mis Quarterly, 21*(4), 389-400.

Goodhue, D. L. (2007). *Comment on benbasat and barki's "quo vadis TAM" article* Association for Information Systems.

Guimaraes, T., & Saraph, J. V. (1991). The role of prototyping in executive decision systems. *Information & Management, 21*(5), 257-267.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, New Yersey 07458: Pearson Prentice Hall.

Hasan, H., & Lampitsi, S. (1995). Executive access to information-systems in australian public organizations. *Journal of Strategic Information Systems, 4*(3), 213-223.

Hirschheim, R. (2007). Introduction to the special issue on "quo vadis TAM -- issues and reflections on technology acceptance research". *Journal of the Association for Information Systems, 8*(4), 204-205.

Hong, W. Y., Thong, J. Y. L., Wong, W. M., & Tam, K. Y. (2001). Determinants of user acceptance of digital libraries: An empirical examination of individual differences and system characteristics. *Journal of Management Information Systems, 18*(3), 97-124.

Houdeshel, G., & Watson, H. J. (1987). The management information and decision support (mids) system at lockheed-georgia. *Mis Quarterly, 11*(1), 127-140.

Hung, S. Y. (2003). Expert versus novice use of the executive support systems: An empirical study. *Information & Management, 40*(3), 177-189.

Igbaria, M. (1993). User acceptance of microcomputer technology - an empirical-test. *Omega-International Journal of Management Science, 21*(1), 73-90.

Igbaria, M., Guimaraes, T., & Davis, G. B. (1995). Testing the determinants of microcomputer usage via a structural equation model. *J.Manage.Inf.Syst., 11*(4), 87-114.

Igbaria, M., & Iivari, J. (1995). Effects of self-efficacy on computer usage. *Omega-International Journal of Management Science, 23*(6), 587-605.

Igbaria, M., & Tan, M. (1997). The consequences of information technology acceptance on subsequent individual performance. *Information & Management, 32*(3), 113-121.

Igbaria, M., Zinatelli, N., Cragg, P., & Cavaye, A. L. M. (1997). Personal computing acceptance factors in small firms: A structural equation model. *Mis Quarterly, 21*(3), 279-305.

Ikart, E. M. (2005). *A theory-based model for the study of executive information systems adoption by the top-level managers*

Jackson, C. M., Chow, S., & Leitch, R. A. (1997). Toward an understanding of the behavioral intention to use an information system. *Decision Sciences, 28*(2), 357-389.

Jackson, K. M., & Trochim, W. M. K. (2002). Concept mapping as an alternative approach for the analysis of open-ended survey responses. *Organizational Research Methods, 5*(4), 307-336.

Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard--measures that drive performance. *Harvard Business Review, 70*(1), 71-79.

Karahanna, E., & Straub, D. W. (1999). The psychological origins of perceived usefulness and ease-of-use. *Information & Management, 35*(4), 237-250.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *Mis Quarterly, 23*(2), 183-213.

Karten, N. (1987). Why executives don't compute. *Information Strategy, 4*(1), 38.

Kogan, J. N. (1986). Information for motivation: A key to executive information systems that translate strategy into results for management. *DSS 86 Transactions,* , 6-13.

Krippendorff, K. (2004). In SAGE Publications Inc (Ed.), *Content analysis: An introduction to its methodology* (2nd Revised edition ed.)

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of AIS, 2003*(12), 752-780.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management, 40*(3), 191-204.

Lucas Jr., H. C., Burton Swanson, E., & Zmud, R. W. (2007). Implementation, innovation, and related themes over the years in information systems research. *Journal of the Association for Information Systems, 8*(4), 206-210.

Madlin, N. (1986, 08). Executive information systems. *Management Review,* , 21-22.

Marginson, D., King, M., & McAulay, L. (2000). Executives' use of information technology: Comparison of electronic mail and an accounting information system. *Journal of Information Technology, 15*(2), 149-164.

Martin, N. J., & Rice, J. L. (2010). Building better government IT: Understanding community beliefs and attitudes toward smart card technologies. *Behaviour & Information Technology, 29*(4), 433-444.

Martinsons, M. G., & Davison, R. M. (2007). Strategic decision making and support systems: Comparing american, japanese and chinese management. *Decision Support Systems, 43*(1), 284-300.

Mawhinney, C. H., & Lederer, A. L. (1990). A study of personal-computer utilization by managers. *Information & Management, 18*(5), 243-253.

McBride, N. (1997). The rise and fall of an executive information system: A case study. *Information Systems Journal, 7*(4), 277-287.

Miles, M. B., & Huberman, A. H. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, California: SAGE Publications, Inc.

Mohan, L., Holstein, W. K., & Adams, R. B. (1990). Eis - it can work in the public-sector. *Mis Quarterly, 14*(4), 435-448.

Morgan, D. L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research, 8*(3), 362-76.

Nabitz, U., Van den Brink, W., & Jansen, P. (2005). Using concept mapping to design an indicator framework for addiction treatment centres. *International Journal for Quality in Health Care, 17*(3), 193-201.

Nabitz, U., Severens, P., Brink, W. V. D., & Jansen, P. (2001). Improving the EFQM model: An empirical study on model development and theory building using concept mapping. *Total Quality Management, 12*(1), 69.

Nandhakumar, J., & Avison, D. E. (1999). The fiction of methodological development: A field study of information systems development. *Information Technology & People, 12*(2), 176-191.

Pijpers, G. G. M., Bemelmans, T. M. A., Heemstra, F. J., & van Montfort, K. A. G. M. (2001). Senior executives' use of information technology. *Information and Software Technology, 43*(15), 959-971.

Pijpers, G. G. M., & van Montfort, K. (2006). An investigation of factors that influence senior executives to accept innovations in information technology. *International Journal of Management, 23*(1), 11-23.

Poon, P., & Wagner, C. (2001). Critical success factors revisited: Success and failure cases of information systems for senior executives. *Decision Support Systems, 30*(4), 393-418.

Puuronen, S., & Savolainen, V. (1997). Mobile information systems - executives' view. *Information Systems Journal, 7*(1), 3-20.

Rainer, R. K., & Watson, H. J. (1995). What does it take for successful executive information-systems. *Decision Support Systems, 14*(2), 147-156.

Ramsay, J. O. (1982). Some statistical approaches to multidimensional scaling data. *Journal of the Royal Statistical Society.Series A (General), 145*(3), pp. 285-312.

Roberts, P., & Henderson, R. (2000). Information technology acceptance in a sample of government employees: A test of the technology acceptance model. *Interacting with Computers, 12*(5), 427-443.

Rockart, J. F. (1979). Chief executives define their own data needs. *Harvard Business Review, 57*(2), 81-93.

Rockart, J. F., & Crescenzi, A. D. (1984). Engaging top management in information technology. *Sloan Management Review, 25*(4), 3-16.

Rockart, J. F., & DeLong, D. W. (1988). *Executive support systems: The emergence of top management computer use*. Illinois: Dow Jones-Irwin.

Rockart, J. F., & Morton, M. S. S. (1984). Implications of changes in information technology for corporate-strategy. *Interfaces, 14*(1), 84-95.

Rockart, J. F., & Treacy, M. E. (1982). The ceo goes online. *Harvard Business Review, 60*(1), 82-88.

Rosas, S. R. (2005). Concept mapping as a technique for program theory development: An illustration using family support programs. notes. *American Journal of Evaluation, 26*(3), 389-401.

Rosas, S. R., & Camphausen, L. C. (2007). The use of concept mapping for scale development and validation in evaluation. *Evaluation and Program Planning, 30*(2), 125-135.

Salmeron, J. L. (2002). EIS evolution in large spanish businesses. *Information & Management, 40*(1), 41-50.

Salmeron, J. L., & Herrero, I. (2005). An AHP-based methodology to rank critical success factors of executive information systems. *Computer Standards & Interfaces, 28*(1), 1-12.

Seeley, M., & Targett, D. (1999). Patterns of senior executives' personal use of computers. *Information & Management, 35*(6), 315-330.

Seeley, M. E., & Targett, D. (1997). A senior executive end-user framework. *Information Systems Journal, 7*(4), 289-308.

Seyal, A. H., & Pijpers, G. G. M. (2004). Senior government executives' use of the internet: A bruneian scenario. *Behaviour & Information Technology, 23*(3), 197-210.

Shepard, R. N., & Kruskal, J. B. (1964). Nonmetric methods for scaling and for factor-analysis. *American Psychologist, 19*(7), 557-558.

Stenfors, S., Tanner, L., Syrjanen, M., Seppala, T., & Haapalinna, I. (2007). Executive views concerning decision support tools. *European Journal of Operational Research, 181*(2), 929-938.

Stevenson, M. (1994). He sees all, he knows all. *Canadian Business, Special Technology Issue, 67*(3), 26-35.

Straub, D., Keil, M., & Brenner, W. (1997). Testing the technology acceptance model across cultures: A three country study. *Information & Management, 33*(1), 1-11.

Straub, D. W., & Burton-Jones, A. (2007). Veni, vidi, vici: Breaking the TAM logjam. *Journal of the Association for Information Systems, 8*(4), 223-229.

Sutherland, S., & Katz, S. (2005). Concept mapping methodology: A catalyst for organizational learning. *Evaluation and Program Planning, 28*(3), 257-269.

Szajna, B. (1996). Empirical evaluation of the revised technology acceptance model. *Management Science, 42*(1), 85-92.

Tang, V. (1991). The organizational implications of an eis implementation. *Journal of Systems Management, 42*(11), 10-12.

Trochim, W. M., Cabrera, D. A., Milstein, B., Gallagher, R. S., & Leischow, S. J. (2006). Practical challenges of systems thinking and modeling in public health. *American Journal of Public Health, 96*(3), 538-546.

Trochim, W. M. K. (1985). Pattern matching, validity, and conceptualization in program evaluation. *Evaluation Review, 9*(5), 575-604.

Trochim, W. M. K. (1989a). Concept mapping : Soft science or hard art? *Evaluation and Program Planning, 12*(1), 87-110.

Trochim, W. M. K. (1989b). An introduction to concept mapping for planning and evaluation. *Evaluation and Program Planning, 12*(1), 1-16.

Trochim, W. M. K., & Linton, R. (1986). Conceptualization for planning and evaluation. *Evaluation and Program Planning, 9*(4), 289-308.

Trochim, W. M. K., Milstein, B., Wood, B. J., Jackson, S., & Pressler, V. (2004). Setting objectives for community and systems change: An application of

concept mapping for planning a statewide health improvement initiative. *Health Promotion Practice, 5*(1), 8-19.

Trochim, W. W. K. (1993). The reliability of concept mapping. *Annual Conference of the American Evaluation Association,* Dallas, Texas.

Trochim, W., & Kane, M. (June 2005). Concept mapping: An introduction to structured conceptualization in health care. *International Journal for Quality in Health Care, 17*(3), 187-191.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research, 11*(4), 342-365.

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences, 27*(3), 451-481.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186-204.

Venkatesh, V., Davis, F. D., & Morris, M. G. (2007). Dead or alive? the development, trajectory and future of technology adoption research. *Journal of the Association for Information Systems, 8*(4), 267-286.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *Mis Quarterly, 27*(3), 425-478.

Vlahos, G. E., & Ferratt, T. W. (1995). Information technology use by managers in greece to support decision making: Amount, perceived value, and satisfaction. *Information & Management, 29*(6), 305-315.

Volonino, L., & Watson, H. J. (1990). The strategic business objectives method for guiding executive information systems development. *Journal of Management Information Systems, 7*(3), 27-39.

Volonino, L., Watson, H. J., & Robinson, S. (1995). Using eis to respond to dynamic business conditions. *Decision Support Systems, 14*(2), 105-116.

Wang, P., & Turban, E. (1991). Filtering strategic environmental information processing using EIS. *Proceedings of the Twenty-Fourth Annual Hawaii International Conference,* Kauai, HI, USA. *, 3.* pp. 126-134.

Watson, H. J. (1990). Avoiding hidden EIS pitfalls. *Computerworld, 24*(26), 87.

Watson, H. J. (2006). Dashboards and scorecards. *Business Intelligence Journal, 11*(2), 4-7.

Watson, H. J., & Frolick, M. N. (1993). Determining information requirements for an EIS. *Mis Quarterly, 17*(3), 255-269.

Watson, H. J., Houdeshel, G., & Rainer, R. K. (1997). *Building executive information systems and other decision support applications*. New York: John Wiley.

Watson, H. J., Rainer, R. K., & Koh, C. E. (1991). Executive information-systems - a framework for development and a survey of current practices. *Mis Quarterly, 15*(1), 13-30.

Witkin, B. R., & Trochim, W. W. K. (1997). Toward a synthesis of listening constructs: A concept map analysis. *International Journal of Listening, 11*(1), 69.

Wöber, K., & Gretzel, U. (2000). Tourism managers' adoption of marketing decision support systems. *Journal of Travel Research, 39*(2), 172-181.

Xu, X. Z. M., & Kaye, G. R. (2002). Knowledge workers for information support: Executives' perceptions and problems. *Information Systems Management, 19*(1), 81-88.

Yampolskaya, S., Nesman, T. M., Hernandez, M., & Koch, D. (2004). Using concept mapping to develop a logic model and articulate a program theory: A case example. *American Journal of Evaluation, 25*(2), 191-207.

Yi, Y. D., Wu, Z., & Tung, L. L. (2005). How individual differences influence technology usage behavior? toward an integrated framework. *Journal of Computer Information Systems, 46*(2), 52-63.

Young, D., & Watson, H. J. (1995). Determinates of EIS acceptance. *Information & Management, 29*(3), 153-164.

Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007a). Technology acceptance: A meta-analysis of the TAM: Part 1. *Journal of Modelling in Management, 2*(3), 251-280.

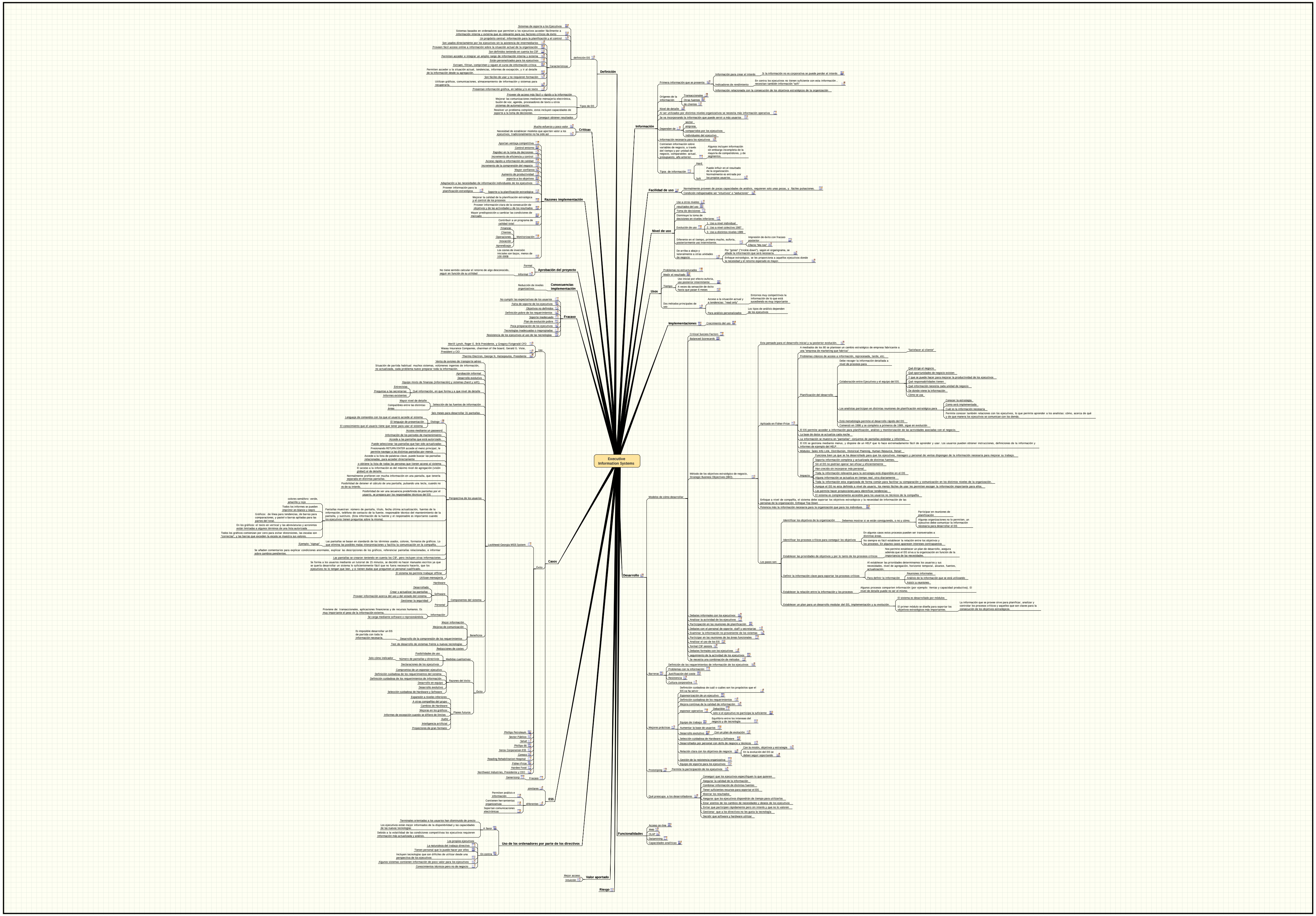
Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007b). Technology acceptance: A meta-analysis of the TAM: Part 2. *Journal of Modelling in Management, 2*(3), 281-304.

Zairi, M., Oakland, J., & Chang, S. (1998). Achieving a successful EIS: Linking TQM and best practice. *Integrated Manufacturing Systems, 9*(1), 50-61.

Zmud, R. W. (1986). In McLean E.R., & H. G. Sol (Eds.), *Decision support systems: A decade in perspective* (pp. 87-101). North-Holland, Amsterdam: Elsevier Science Publishers B.V.

8. Annexes

Annex 1: EIS state of the art conceptual map



Executive Information Systems
Definición
Críticas
Razones implementación
Aprobación del proyecto
Consecuencias implementación
Fracaso
Casos
ESS
Uso de los ordenadores por parte de los directivos
Valor aportado
Riesgo
Información
Facilidad de uso
Nivel de uso
Usos
Implementaciones
Desarrollo
Funcionalidades

Annex 2: Paper - "Framework for the analysis of executive information systems based on the perceived usefulness and the perceived ease of use"

Intangible Capital

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

Framework for the analysis of executive information systems based on the perceived usefulness and the perceived ease of use

Josep Lluís Cano Giner
ESADE Business School
(Spain)
joseplluis.cano@esade.edu

Vicenc Fernandez
Universitat Politècnica de Catalunya
(Spain)
vicenc.fernandez@upc.edu

Marta Díaz Boladeras
Universitat Politècnica de Catalunya
(Spain)
marta.diaz@upc.edu

Received September, 2009
Accepted November, 2009

Abstract:

The acquisition and use of information are key factors in successful executive performance. Although there are various and different media that executives use to obtain information, in the last decade the academic research has emphasised computer-based systems. Inside this group of systems, we can find the Executive Information Systems (EIS), which are tools that can help executives to obtain relevant informationmore efficiently.Recently, EIS have been analyzed through the Technology Acceptance Model (TAM) with significant results. A deeper review of these results, the existing literature, as well as our own experience, suggest there are some factors that affect to the use of EIS indirectly or as moderating variables, instead of directly as recent studies suggest. The objective of our research is to propose a framework based on the TAM, which shows the different types of factors that affect to the *Perceived Usefulness (U)* and *Perceived Ease of Use*(EOU) of EIS, as well as how the kind of influence of these factors on *U* and *EOU*.

Intangible Capital

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

Keywords: executive information systems, technology acceptance model, qualitative research.

JEL Codes: D83

1. Introduction

It is assumed that efficient acquisition and use of information are key factors in successful executive performance (Mintzberg, 1973). In this sense, a great amount of management references point out the central role of information to make decisions and to plan strategy, and outline the informational and decisional aspects of management (Belcher & Watson, 1993; Houdeshel & Watson, 1987; Rockart & DeLong, 1988; Volonino, Watson, & Robinson, 1995).

The traditional media that executives have used to obtain information are documents, scheduled and unscheduled meetings, telephone calls, and observational tours. However, in the last decade the academic research has emphasised computer-based systems. Inside this group of systems, we can find the Executive Information Systems (EIS), which are tools that can help executives to get relevant information more efficiently. One of the first papers showing the use and adoption of EIS was "The CEO goes on-line" (Rockart & Treacy, 1982), in which the authors put forward different examples of EIS used by executives.

Nowadays, we can find several researches about EIS (Salmeron & Herrero, 2005; Young & Watson, 1995; Watson, Rainer, & Koh, 1991; Leidner, Carlsson, & Elam, 1995; Nord & Nord, 1995) that analyse the success factors and the reasons why executives use EIS. From another point of view, Pijpers, Bemelmans, Heemstra, and van Montfort (2001) review the use of EIS through the Technology Acceptance Model (TAM) (Davis, 1989; Venkatesh & Davis, 1996; Burton-Jones & Hubona, 2006), and propose that a small number of antecedent variables influence actual use. However, a deeper review of the literature and practice our own experience suggest that many of these factors affect the use of EIS indirectly or as moderate variables, instead of directly.In this context, the objective of our research is to propose a framework based on the Technology Acceptance Model where we can identify different types of factors, their relative importance, and how they affect

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

the core variables: *Perceived Usefulness* and *Perceived Ease of Use* of Executive Information Systems.

We have carried out an exploratory study based on interviews with Spanish executives from international firms and a review of the literature about Information System and more specifically the EIS in organization. The results can contribute to define new EIS tools and to manage EIS projects more efficiently. It could be one way of increasing EIS use among executives, thus improving their work and reducing the number of EIS project failures.

2. Review of the literature

Obtaining relevant information is a crucial and necessary process for decision-making in organizations (Mintzberg, 1973), but this information should be correctly modelled to maximize the performance of the organizational decisions (Kaplan & Norton, 1992; Little, 1970; Little, 2004; Rockart, 1979). Besides, it is necessary to develop practicable and usable systems (Brady, 1967) that can help executives in decisions making. In this line, the Information Technologies can help executives mainly in improving delivery of their products and services and potentially increase their effectiveness and productivity in business administration (Rockart & Crescenzi, 1984).

A key question addressed by researchers and practitioners is how computers can change management decision-making. Brady (1967) suggested that computers had not much impact on top-level decision-making. Brady also noticed different reasons why managers were not making maximum use of the computer: lack of appreciation (or even education), a defensive attitude, a lag in the development of currently practicable systems which are geared primarily to assist top managers in making decisions, hesitancy on the part of some top managers to formally identify the criteria which they wish used in decision making, a tendency for top managers to wait for other firms to incur the expense and risk of pioneering and testing new areas of computer applications.

Henry Mintzberg (1973) proposed that the acquisition and use of information are key factors in successful executive performance, stressing the informational and decisional aspects of management. From that research until now, it has appeared a great amount of management references, which show the central role of

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

information to make decisions and to plan strategy (Belcher & Watson, 1993; Houdeshel & Watson, 1987; Rockart & DeLong, 1988; Volonino et al., 1995). Later, Rockart (1979) worked in a method of providing information to top management, which was called 'Critical Success Factors' (CSF). 'CSF thus are, for any business the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization'. Recently, researchers have developed new models to help executives to manage resources as Balanced Scorecard (Kaplan & Norton, 1992).

Executive Information Systems (EIS)

Executive Information Systems (EIS) are flexible tools that provide broad and deep information support and analytic capability for a wide range of executive decision-making (Houdeshel & Watson, 1987; Rockart & DeLong, 1988). EIS content internal and external data (Watson et al., 1991; Young & Watson, 1995), which comes from different sources of information with different origins: transactional systems, financial reporting systems, commercial information sources, text files and manual recollection (Vandenbosch & Huff, 1997). EIS's may also include environmental scanning data, access to external databases (Young & Watson, 1995) and soft information (Watson, OHara, Harp, & Kelly, 1996). EIS support the work of senior management by providing rapid access to critical information (Arnott, Jirachiefpattana, & O'Donnell, 2007) and executives must utilize this software technology for strategic decision-making and managing daily business activities in order to remain competitive (Nord & Nord, 1995).

The main characteristics of EIS summarized by Young and Watson (1995) are: (a) direct, hands-on usage by top executives, that implies that executives are direct users of EIS; (b) a repository for compressing, filtering, organizing, and delivering data; (c) "drilling down" to examine supporting detail, EIS should permit going throw more aggregated to more detailed data; (d) reporting exception conditions to highlight variances, as alerts; (e) combining text, graphics, and tabular data on one screen, to facilitate interpretation by executives; (f) offering internal and external data; (g) monitoring key performance indicators, or other variables; (h) providing current status access to performance data, in right time; (i) tailoring the EIS to each user's decision-making style in order to adapt to his o her necessities; (j) focusing on the information needs of each executive, there are differences

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

between executives information necessities; (k) tracking critical success factors; (l) incorporating both hard data (e.g., sales figures) and soft data (e.g., opinions).

EIS access data from datamarts and/or datawarehouses. On one hand, these data stores make it easer to access clean, consistent, integrated data (Singh, Watson, & Watson, 2002). On the other hand, the introduction of data warehousing technology and Online Analytical Processing (OLAP) techniques has improved traditional EIS (Chen, 1995). Most EIS use also a Web browser for the user interface, which provides easy access to data and even –some of them – data mining capabilities (Singh et al., 2002). There is also a change in EIS users, EIS used to be reserved to executives but nowadays the use of EIS is moving down the organizational structure (Nord & Nord, 1995; Stein, 1995; Volonino et al., 1995)

In general, the terms Executive Information Systems (EIS) and Executive Support Systems (ESS) have been used interchangeably by the literature. However, an ESS is usually considered to be a system with more capabilities than an EIS (Rockart & DeLong, 1988; Watson et al., 1991). While EIS implies a system providing summary information for executives, ESS is a comprehensive support system that goes beyond providing information to include communications, data analysis, office automatization, organizing tools and intelligence.

There are many examples about the use of EIS by organizations reported in the literature in different contexts and for different specific purposes: Lockheed-Georgia MIDS System (Houdeshel & Watson, 1987); several examples (Rockart & DeLong, 1988); Public sector (Mohan, Holstein, & Adams, 1990); Conoco (Belcher & Watson, 1993); some pitfalls (Bussen & Myers, 1997; Watson, 1990); Nestle (Oggier, Fragniere, & Stuby, 2005), EIS uses in human resources (Schenk & Holzbach, 1993), in strategic management process (Singhet al., 2002; Walters, Jiang, & Klein, 2003). Other lines of research are related with the information that EIS content (Volonino et al., 1995), how to select the information for an EIS (Volonino & Watson, 1990), about the users (Stein 1995; Walstrom & Wilson 1997a, 1997b), the use in concrete markets or in emerging economies (Arnottet al., 2007; Salmeron, 2002a), technologies related with EIS (Cheung & Babin, 2006a, 2006b; Chi & Turban, 1995; Frolick & Ramarapu, 1993; Gopal & Tung, 1999).

Intangible Capital
©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

Success is far from guaranteed and failures are common in EIS projects (Bussen & Myers, 1997; Watson, 1990; Young & Watson, 1995). Nowadays, we can find several researches about EIS that analyse the success factors and the reasons why executives use EIS (Leidner et al., 1995; Nord & Nord, 1995; Salmeron & Herrero, 2005; Watson, Rainer, & Koh, 1991; Young & Watson, 1995). The study conducted by Rainer and Watson (1995) point out that the main key to successfully maintaining ongoing EIS is "ease of use".

Technology Acceptance Model

The Technology Acceptance Model (TAM) (Burton-Jones & Hubona, 2006; Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 1996; Venkatesh & Davis, 2000; Venkatesh, 2000) is widely used by researches and practitioners to predict and explain user acceptance of information technologies. TAM (Figure 1) was designed to understand the casual chain linking external variables to its user acceptance and actual use.

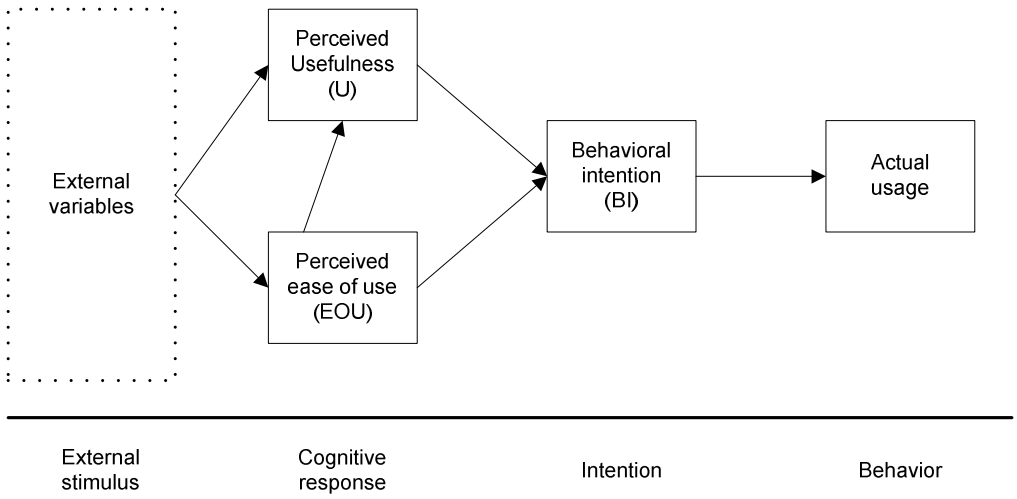


Figure 1. "Technology Acceptance Model (TAM)". Source: Davis et al., 1989

Research in TAM suggests that users' intention to use (BI) is the single best predictor of actual system usage. The intention to use is determined by one's attitude towards using. This attitude is determined by perceived usefulness (U) and perceived ease of use (EOU). Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his o her job performance. On the other hand, the perceived ease of use refers to the degree to

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

which a person believes that using a particular system would be free of effort (Davis et al., 1989). They concluded their research with three main insights:

- People's computer use can be predicted reasonably well from their intentions.
- Perceived usefulness is a major determinant of people's intentions to use computers.
- Perceived ease of use is a significant secondary determinant of people's intentions to use computers.

Davis (1989) developed new scales to assess perceived usefulness and perceived ease of use. These scales exhibited high convergent, discriminant, and factorial validity. After this work, Venkatesh and Davis (2000) and Venkatesh (2000) extended the model to a new version called TAM2. Finally, they develop two longitudinal field experiments that showed that pre-prototype usefulness measures could closely approximate hands-on based usefulness measures, and are significantly predictive of usage intentions and behaviour up to six months after workplace implementation.

Main external variables or factors– these terms are used interchangeably in TAM (Davis, 1989) – are related both to individuals, design and contextual variables are: objective design characteristics, training, computer self-efficacy, user involvement in design, and the nature of the implementation process (Davis & Venkatesh, 1996), system's technical design characteristics, user involvement in system development, the type of system development process used, cognitive style, training, documentation, user support consultants, system features, user characteristics, ultimate behaviour (Davis et al., 1989). Further analysis based on reviewed the articles published which notes that there is no clear pattern with respect to the choice of the external variables considered (Legris, Ingham, & Collerette, 2003). The authors also remarked the 39 factors affecting information system satisfaction (Bailey & Pearson, 1983) and proposed a factor's classification (Cheney, Mann, & Amoroso 1986).

Later, there has been an attempt to unify the user acceptance of information technology factors (Venkatesh, Morris, Davis, & Davis, 2003), but they do not take

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

into account the characteristics of the software solution nor the characteristics of the implementation project can affect the perceived usefulness (U) or the perceived ease of use (EOU). Pijpers et al. (2001) selected the external variables from Venkatesh and Davis works (1996, 2000) and categorized them in four groups: individual characteristics, organizational characteristics, task-related characteristics and characteristics of the information technology resource.

The goal of this paper is to establish a framework that can help us to understand why some EIS systems are adopted and used successfully in companies' administration and others are not. From the previous review of the literature, we have been able to identify many factors that can explain this process. However, the results of some researches and our own experience in the EIS development suggest that there are more factors than the current identified ones. Besides, we made out that many of these factors affect to the final result indirectly or as moderate variables, instead of directly as stated in the majority of papers.

3. Method

This research aims to study the adoption process that involves many and diverse actors and stakeholders, complex collaborative processes, technologies, and contexts. Moreover and although there are many researches about the Information Systems and more specifically the EIS in organizations, this area is very young in comparison to other areas into the social sciences. Due to these facts, we have proposed an exploratory inductive research to get a framework that can help to design and develop successful –acceptable, usable and useful – EIS tools.

We have carried out an empirical study that consists in depth interviews to nine Spanish executives from multinational firms. In this context, we have preferred the qualitative approach that provides comprehension of the complex social processes that we investigate. We prepared the interviews scripts according to the review of the literature about the success and failure of EIS and some of our perceptions about the use of them. The interviews were personal and private, following a semi-structured script, where the interviewees were asked about their experience in the use of EIS.

The interviews had two parts. The first section was made up of various relevant questions according to the review of the literature. For instance, we asked to the

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

interviews about individual characteristics (demographics, professional experience, personality of the manager, individual culture, etc.), group characteristics (group size, group maturity, commitment, etc.), organizational characteristics (organizational structure, organizational culture, competitor behaviour, etc.), task-related characteristics (difficulty and variability), project characteristics (management, time, etc.) and characteristics of the Information Technology (accessibility, interface, formation, etc.).

In the second section, we proposed to the interviewees to explain how an EIS should be really a useful tool for successfully project management. In both sections, interviewees were allowed to freely explain any idea or perception about the topics, without time constrain.

4. Analysis and results

The interviews were recorded digitally and transcribed. The information of the interviews were reduced and processed following the strategies proposed by Miles & Huberman (1994). The reduction of data was centred on referring all the fragments to two main factors: perceived easy of use and perceived usefulness of EIS. This step permitted us to reduce various pages of interviews into a smaller number of analytic units. Then, we created a checklist matrix to coherently organize several components of every interview. The matrix had the different interviews in the rows and the topics (individual characteristics, group characteristics, organizational characteristics, task-related characteristics, characteristics of Information Technolgies, etc.) in the columns. Finally, we get the factors or antecedent variables into two groups: factors that can affect to the perceived easy of use of EIS and factors that can affect to the perceived usefulness of EIS.

We identified nine factors in the first group (the perceived easy of use of EIS): (a) Easy to know what is the information that the EIS content; (b) Easy to know the model which support the information; (c) EIS content information that you are interested in; (d) Easy navigation from aggregated information to detailed information; (e) Help should be simple, short and clear, but they prefer initial training; (f) The same "functionalities" than Windows or Web; (g) Easy to learn; (h) Easy to remember; and (i) Easy to interpret the information: graphic, tables,

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

etc. On the other hand, we detected six factors in the second group (the perceived usefulness of EIS): (a) The first screen must content the most important information of the most important key areas; (b) If there is a problem that you can realize about it and going throwing the details; (c) "Something", likes a map that helps you when you are getting lost; (d) Know how the calculation is done (Have the possibility to check the formulas); (e) Multidimensionality; and (f) Spend little time to find the information that you need.

These results coincide with Human Computer Interaction (HCI) studies in Management Information Systems (MIS) that are concerned with the ways people interact with information, technologies, and tasks, especially in business, managerial, organizational, and cultural contexts (Zhang & Li, 2004). These authors consider that the interaction experience is relevant and important only when people use technologies to support their primary tasks within certain contexts, being organizational, social or societal, so there is an interaction between systems and users. So we suggest the next proposition:

- Proposition 1: The characteristics of the system are related to the perceived ease of use and the perceived usefulness of EIS.

The executives' implication in the EIS's project is another group of characteristics that is considered in the literature (Bajwa, Rai, & Brennan, 1998; Belcher & Watson, 1993; Houdeshel & Watson, 1987; Leidner, Carlsson, & Elam, 1995; Leidner & Elam, 1995; Mohan et al., 1990; Nord & Nord, 1995; Poon & Wagner, 2001; Rockart & DeLong, 1988; Rockart, 1979; Rockart & Treacy, 1982; Rockart & Crescenzi, 1984; Salmeron, 2002b; Schenk & Holzbach, 1993; Volonino & Watson, 1990; Walstrom & Wilson, 1997b; Watson et al., 1991; Watson & Frolick, 1993) and that is reflected in the results of our study. In this sense we suggest the following proposition:

- Proposition 2: The implication of executives in the EIS project implementation is related to the perceived ease of use and the perceived usefulness of EIS.

Finally, we have detected that the degree of influence of the previous characteristics – systemdesign and executives' implication– onthe perceived ease of use and the perceived usefulness of EIS is moderated by other kind of

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

characteristics: for instance, the individual and organizational characteristics. For example, traditionally the age has been considered as a direct factor on the perceived easy of use and the perceived usefulness of EIS. However, our results suggest that the age could be a moderating variable of the characteristics of the system and the implication of the executives in the project.

- Proposition 3: Individual and organizational factors have a moderating effect between the characteristics of the system and project, and the perceived ease of use and the perceived usefulness of EIS.

5. Conclusions

In our opinion, Technology Acceptance Model is a useful tool to validate our preliminary results. However, we consider that it is necessary to adapt the model introducing the influence of EIS design and of the project characteristics. Besides, we suggest that there could be a set of factors that moderates the system and project characteristics. According to this model, we have proposed three propositions that have been translated graphically in the Figure 2. As this one, the external characteristics can modulate the effects of the system design and project characteristics.

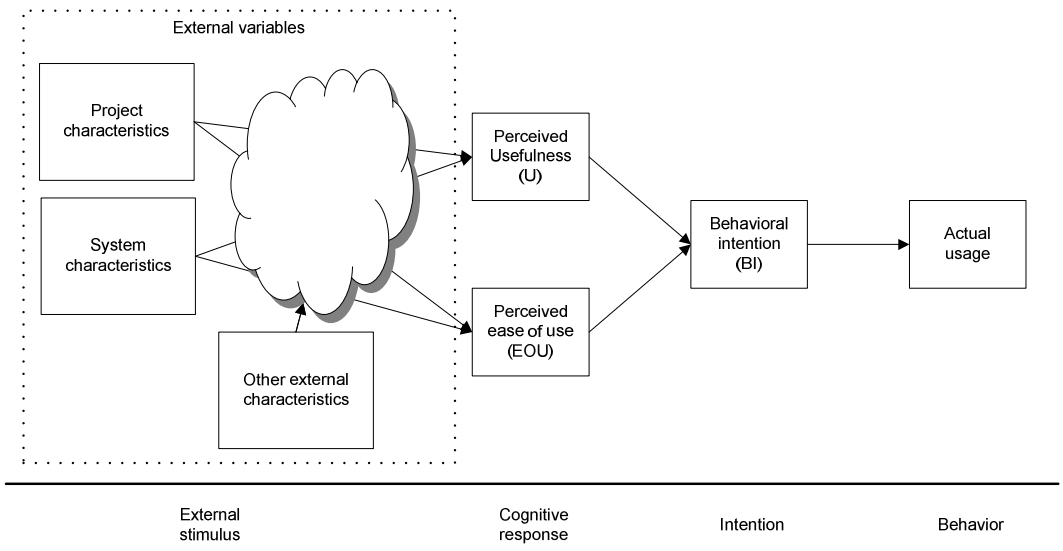


Figure 2. "Adapted Technology Acceptance Model". Source: authors

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

Based on preliminary results of gathered data, the interaction between the executive and the EIS, as well as the interaction between the executive and the EIS's implementation project can affect perceived usefulness and perceived easy of use. Other external variables as age, gender, or professional experience can also modulate the effects of system or project characteristics. These relationships appeared in our interviews, so we should work in deep to identify and assess the antecedent variables and also test TAM for EIS. We propose to keep working in this line, developing a new research where to interview more executives and to use other information sources to explore what the antecedent variables are. Respondents should be asked directly which factors are or the EIS system or the EIS project that affect usefulness or ease of use rather than to respond to a predefined list and after they have responded they should fill a questionnaire with questions relatives to other external variables to establish the possible relationships.

These results could contribute to define new EIS tools and to manage EIS projects more efficiently. It could be one way of increasing EIS use among executives, thus improving their work and reducing the number of EIS project failures. In our research we find that we can't miss the relationship between the executive and the EIS system because it seems there is here the main cause of the success o the failure, so we should adapt the EIS at the executives' demands.

References

ARNOTT, D.; JIRACHIEFPATTANA, W.; O'DONNELL, P. (2007). Executive information systems development in an emerging economy. *Decision Support Systems*, 42(4): 2078-2084.

BAILEY, J.E.; PEARSON, S.W. (1983). Development of a tool for measuring and analyzing computer user satisfaction. *Management Science*, 29(5): 530-545.

BAJWA, D.S.; RAI, A.; BRENNAN, I. (1998). Key antecedents of executive information system success: A path analytic approach. *Decision Support Systems*, 22(1): 31-43.

BELCHER, L.W.; WATSON, H.J. (1993). Assessing the value of conocos eis. *MIS Quarterly*, 17(3): 239-253.

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

BRADY, R.H. (1967). Computers in top-level decision making. *Harvard business review*,45(4): 67-76.

BURTON-JONES, A.; HUBONA, G.S. (2006). The mediation of external variables in the technology acceptance model. *Information & Management*, 43(6): 706-717.

BUSSEN, W.; MYERS, M.D. (1997). Executive information system failure: A new Zealand case study. *Journal of Information Technology*, 12(2): 145-153.

CHEN, M. (1995). A model-driven approach to accessing managerial information: The development of a repository-based executive information system. *Journal of Management Information Systems*, 11(4): 33-63.

CHENEY, P.H.; MANN, R.I.; AMOROSO, D.L. (1986). Organizational factors affecting the success of end-user computing. *Journal of Management Information Systems*,3(1): 65-80.

CHEUNG, W.; BABIN, G. (2006a). A metadatabase-enabled executive information system (part A): A flexible and adaptable architecture. *Decision Support Systems*, 42(3): 1589-1598.

CHEUNG, W.; BABIN, G. (2006b). A metadatabase-enabled executive information system (part B): Methods for dynamic multidimensional data analysis. *Decision Support Systems*, 42(3): 1599-1612.

CHI, R.T.; TURBAN, E. (1995). Distributed intelligent executive information-systems. *Decision Support Systems*, 14(2): 117-130.

DAVIS, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3): 319-340.

DAVIS, F.D.; BAGOZZI, R.P.; WARSHAW, P.R. (1989). User acceptance of computer-technology - a comparison of 2 theoretical-models. *Management Science*, 35(8): 982-1003.

DAVIS, F.D.; VENKATESH, V. (1996). A critical assessment of potential measurement biases in the technology acceptance model: Three experiments. *International Journal of Human-Computer Studies*, 45(1): 19-45.

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

FROLICK, M.; RAMARAPU, N.K. (1993). Hypermedia - the future of eis. *Journal of Systems Management*, 44(7): 32-36.

GOPAL, R.D.; TUNG, Y.A. (1999). An examination of the role of internet technologies in developing next generational executive information systems. *Journal of Computer Information Systems*, 39(3): 81-91.

HOUDESHEL, G.; WATSON, H.J. (1987). The management information and decision support (mids) system at lockheed-Georgia. *MIS Quarterly*, 11(1): 127-140.

KAPLAN, R.S.; NORTON, D.P. (1992). The balanced scorecard--measures that drive performance. *Harvard business review*, 70(1): 71-79.

LEGRIS, P.; INGHAM, J.; COLLERETTE, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, 40(3): 191-204.

LEIDNER, D.E.; CARLSSON, S.; ELAM, J.J. (Eds.). (1995). *A cross-cultural study of executive information systems*. Wailea, HI, USA: System Sciences.

LEIDNER, D.E.; ELAM, J.J. (1995). The impact of executive information systems on organizational design, intelligence, and decision making. *Organization Science*, 6(6): 645-664.

LITTLE, J.D.C. (1970). Models and managers - concept of a decision calculus. *Management Science Series B-Application*, 16(8): B466-B485.

LITTLE, J.D.C. (2004). Comments on "models and managers: The concept of a decision calculus". *Management Science*, 50(12 Supplement): 1854-1860.

MILES, M.B.; HUBERMAN, A.H. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, California: SAGE Publications, Inc.

MINTZBERG, H. (1973). *The nature of managerial work*. New York: Harper and Row.

MOHAN, L.; HOLSTEIN, W.K.; ADAMS, R.B. (1990). EIS - It can work in the public-sector. *MIS Quarterly*, 14(4): 435-448.

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

NORD, J.H.; NORD, G.D. (1995). Why managers use executive support systems - selecting and using information technology for strategic advantage. *Industrial Management & Data Systems*, 95(9): 24-&.

OGGIER, C.; FRAGNIERE, E.; STUBY, J. (2005). Nestle improves its financial reporting with management science. *Interfaces*, 35(4): 271-280.

PIJPERS, G.G.M.; BEMELMANS, T.M.A.; HEEMSTRA, F.J.; VAN MONTFORT, K.A.G.M. (2001). Senior executives' use of information technology. *Information and Software Technology*,43(15): 959-971.

POON, P.; WAGNER, C. (2001). Critical success factors revisited: Success and failure cases of information systems for senior executives. *Decision Support Systems*,30(4): 393-418.

ROCKART, J.F.; DELONG, D.W. (1988). *Executive support systems: The emergence of top management computer use*. Illinois: Dow Jones-Irwin.

ROCKART, J.F. (1979). Chief executives define their own data needs. *Harvard business review*, 57(2): 81-93.

ROCKART, J.F.; CRESCENZI, A.D. (1984). Engaging top management in information technology. *Sloan management review*, 25(4): 3-16.

ROCKART, J.F.; TREACY, M.E. (1982). The CEO goes online. *Harvard business review*, 60(1): 82-88.

SALMERON, J.L. (2002a). EIS evolution in large Spanish businesses. *Information & Management*, 40(1): 41-50.

SALMERON, J.L. (2002b). EIS profitability, costs and benefits: An evolutionary approach. *Industrial Management & Data Systems*, 102(5-6): 284-288.

SALMERON, J.L.; HERRERO, I. (2005). An AHP-based methodology to rank critical success factors of executive information systems. *Computer Standards & Interfaces*,28(1): 1-12.

SCHENK, K.D.; HOLZBACH, R.L. (1993). Getting the job done with HuRBIE: A human resources EIS. *Interfaces*, 23(3): 41-50.

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

SINGH, S.K.; WATSON, H.J.; WATSON, R.T. (2002). EIS support for the strategic management process. *Decision Support Systems*, 33(1): 71-85.

STEIN, A. (1995). Reengineering the executive - the 4th generation of eis. *Information & Management*, 29(1): 55-62.

VANDENBOSCH, B.; HUFF, S.L. (1997). Searching and scanning: How executives obtain information from executive information systems. *MIS Quarterly*, 21(1): 81-107.

VENKATESH, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, 11(4): 342-365.

VENKATESH, V.; DAVIS, F.D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, 27(3): 451-481.

VENKATESH, V.; DAVIS, F.D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2): 186-204.

VENKATESH, V.; MORRIS, M.G.; DAVIS, G.B.; DAVIS, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3): 425-478.

VOLONINO, L.; WATSON, H.J.; ROBINSON, S. (1995). Using eis to respond to dynamic business conditions. *Decision Support Systems*, 14(2): 105-116.

VOLONINO, L.; WATSON, H.J. (1990). The strategic business objectives method for guiding executive information systems development. *Journal of Management Information Systems*, 7(3): 27-39.

WALSTROM, K.A.; WILSON, R.L. (1997a). An examination of executive information system (EIS) users. *Information & Management*, 32(2): 75-83.

WALSTROM, K.A.; WILSON, R.L. (1997b). Gaining user acceptance of an EIS. *Information Systems Management*, 14(1): 54-59.

WALTERS, B.A.; JIANG, J.J.; KLEIN, G. (2003). Strategic information and strategic decision making: The EIS. *Information & Management*, 40(6): 487-495.

©© Intangible Capital, 2009 – 5(4):370-386 – ISSN: 1697-9818
doi: 10.3926/ic.2009.v5n4.p370-386

WATSON, H.J.; FROLICK, M.N. (1993). Determining information requirements for an eis. *MIS Quarterly*, 17(3): 255-269.

WATSON, H.J.; OHARA, M.T.; HARP, C.G.; KELLY, G.G. (1996). Including soft information in EISs. *Information Systems Management*, 13(3): 66-77.

WATSON, H.J.; RAINER, R.K.; KOH, C.E. (1991). Executive information-systems - a framework for development and a survey of current practices. *MIS Quarterly*, 15(1): 13-30.

WATSON, H. (1990). Avoiding hidden EIS pitfalls. , 24(26): 87.

YOUNG, D.; WATSON, H.J. (1995). Determinates of eis acceptance. *Information & Management*, 29(3): 153-164.

ZHANG, P.; LI, N. (2004). An assessment of human-computer interaction research in management information systems: Topics and methods. *Computers in Human Behavior*, 20(2): 125-147.

Annex 3: Paper - “Use of computers and applications by senior executives”

Journal of Industrial Engineering and Management

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953

Print ISSN: 2013-8423

Use of computers and applications by senior executives

Josep Lluís Cano Giner

ESADE Business School (SPAIN)

joseplluis.cano@esade.edu

Received March 2011
Accepted June 2011

Abstract:

Purpose: Analyze the relationship between the senior executive and ICT use.

Design/methodology/approach: Empirical research through which we propose a framework to establish the main factors that might lead to an increase in ICT use by senior executives.

Findings: The main contribution of the present study is the creation of the list of factors that affect the use of computers and applications by senior executives and a smaller group of categories.

Research limitations/implications: A limitation of this research is that it should be confirmed by means of quantitative research that would allow us to test the validity of the proposed framework, and also to ascertain the relative importance of each factor.

Practical implications: Thus reducing the number of factors and forming a smaller group of categories that can facilitate research.

Originality/value: The list of factors that affect the use of computers and applications by senior executives and the smaller group of categories.

Keywords: senior executive, users, information and communication technologies, executive information system

Journal of Industrial Engineering and Management
doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

1 Introduction

The information and communication technologies (ICTs) have increased the productivity of various groups within organisations, but one of the groups that has adopted ICTs least is that of senior executives. The aim of the present paper is to analyse the factors that affect the use of ICTs by senior executives, gathering them together within a reference framework that will enable us to take them into account when implementing systems intended for this group. If senior executives adopted ICTs more widely, they would increase their productivity.

The beginnings of the relationship between ICTs, executives and decision making can be traced back to the times of the first computers. Over the years several arguments have been put forward to explain the lack of computer use among executives, including: their poor keyboard skills, their lack of training and experience in computer use, and even concern about their status, as they felt that using a computer was not part of their job, along with a set of other reasons related to the alternative between the flexibility or simplicity of systems, that is, if systems were inflexible or over-simple they added no value. But there are other cases in which executives overcome these reasons, for example that of Lockheed-Georgia (Houdeshel & Watson, 1987). In the mid 1950s, it was the opinion of most scientists that computers would have a notable impact on scientific calculation (e.g., in astronomy and the military sphere). A few (including Russell Ackoff, John Diebold and J.W. Forrester) agreed that computers would, in the immediate future, revolutionise the work of executives in policies, strategy and decision making (Drucker, 1998). The possibility that computers and applications would affect the way executives work was already anticipated. Although computers existed before this date, 1965 marked an unprecedented change when IBM presented their System/360 family. At that moment, scientists began to ask themselves how computers might help humans to improve decision making. Collaborations between scientists at the Carnegie Institution, together with Marvin Minsky of the Massachusetts Institute of Technology and John McCarthy of Stanford University, developed the first cognitive computer models, which were the embryo of artificial intelligence (Buchanan & O'Connell, 2006).

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

The paper starts with a description of the methodology and a literature review to establish a definition of the senior executive. We then go on to examine the various research projects that have been carried out on the use of applications or computers by senior executives, and conclude with a proposal of what we consider to be the key factors in the development of applications intended for senior executives.

As we will see presently, the key factors are related to the senior executives themselves, the system or application, and the project.

2 Methodology

The paper starts with a review of the existing literature, in two parts: one related to how we define a senior executive, and the other to analyse the relationship between the senior executive and ICT use. In the first part a definition is adopted, on the basis of a single previous literature review, as it is not the purpose of this paper to examine senior executives as such but rather their relationship with ICTs. In this second part we analyse, in chronological order, the contributions of various authors, separating out the reasons against the use of computers and applications by executives; the reasons in favour of the use of computers and applications by executives; and the factors to increase the use of computers and their applications. After analysing the literature, we group the factors according to whether they are related to the senior executives, the system or application, the project, or other reasons; and we propose a framework of factors that should be taken into account to increase ICT use by senior executives.

3 Senior executives

In the present paper we will adopt the definition of the senior executive proposed by Seeley and Targett (1997): "an executive who is concerned with the strategic direction of their organization's business". Furthermore, the senior executive: "is in a position to influence significantly the strategic decision-making processes for their function and/or the organization; has substancial control and authority over how resources are deployed; is in a position to influence the strategic direction of the Business of their function/organization; may have other senior managers reporting to him or her".

Journal of Industrial Engineering and Management
doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

4 Studies on the use of computers and applications by senior executives

There are several studies in the literature that analyse the use made of computers and applications by senior executives. In this section we will describe them.

One of the first studies was conducted by Brady (1967), and addressed the issue of whether computers had changed the method, the form or the content of executives' decision making. He concluded his study stating that computers had had no impact on how executives made decisions. In the same study he indicated that executives were not using computers due to:

- Lack of understanding (or training) of how computers can be used for decision making by executives
- A defensive attitude on the part of some executives regarding the threat posed by computers to their decision-making functions and their prerogatives to exert their "opinion"
- Lack of development of applications intended for decision making
- Indecision on the part of executives in formally identifying the decision-making criteria they wanted to use
- Executives' tendency to wait for other firms to invest and take the risk of pioneering the use of new computer applications

Brady (1967) forecast that significant advances in the impact of computers would be achieved simply as a consequence of the passing of time and staff movements, although he recommended speeding up changes by developing and training both middle and senior executives. In the conclusion of his study he predicted that by the mid 1970s computers would cause changes in a large number of aspects related to executive decision making.

One of the key papers dealing with computer use by executives is "The CEO goes on-line" (Rockart & Treacy, 1982). In it, the authors show how CEOs increasingly access and use information from computers on a regular basis. They describe how four senior executives use computers, specifically with EIS applications (Executive Information Systems), which offer them analytical tools in their search for greater insight into their companies and sectors, the possibility of personalising them to

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

meet each executive's information needs, and the possibility of implementing them by starting with small projects that can grow gradually. EISs are intended to help executives to use information more effectively. The authors conclude their paper with the following statement:

> *"Not all senior managers, of course, will find and EIS system to their taste, but enough user-friendly technology now exists to accommodate the needs of those who wish to master a more data-intensive approach to their jobs".*

PC use by executives was subsequently analysed by Mawhinney and Lederer (1990), employing a model formed by four groups of variables: manager's attributes in the organisation (level, span of control, type of work, control of the system, contribution to job performance), personal attributes (age, sex, level of training, typing skills, competence in using the system), system attributes (ease of learning, ease of use, accessibility, response time, suitability), and process attributes (participation in the acquisition, satisfaction with the system, training in its use, technical support). The authors analyse how these variables affected PC use by the executives, discovering that none of the groups of variables seemed to dominate the model and that the two items with the strongest correlation with reported use time were (1) the system's contribution to job performance and (2) the managers' level of competence with the system.

Managers are reluctant to spend extra time learning other applications when they can do what they want on a spreadsheet, even if this is not the most efficient way of doing it, according to Seeley and Targett (1997). The authors report on several studies analysing senior executives as computer users. In the conclusions of their paper they state that senior executives use computers more extensively than before, that they use a larger number of applications more competently than they used to, and that the number of applications they use can be related to age (younger executives use a wider range of applications).

In his article "The next information revolution" (1998), Drucker investigates the meaning and the purpose of information. The author states that senior executives did not use new technologies because these technologies did not provide them with the information they needed for their work; likewise, he argues that the accounting systems at their disposal do not help them in decision making. Another aspect he

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

highlights is that senior executives have a degenerative tendency, especially in the big corporations: to focus inwards (on costs and results) rather than outwards (on opportunities, changes and threats). Consequently he predicted a trend over the following 10 to 15 years towards collecting outside information. One of the factors that can cause a change in the trend is the stronger training in technologies that he forecasts senior executives will have in the future. Another issue that is addressed is whether system employees and chiefs are prepared to attend to senior executives about ICTs in the medium they require.

In their study on senior executives' personal use of computers, Seeley and Targett (1999) conclude that it is related to the dynamic and complex iteration between both internal factors, such as executives' perception of their role as managers, modus operandi and personality, and certain external factors, such as system infrastructures, the nature of the task and organisational culture.

Poon and Wagner (2001) revise the Critical Success Factors model (Rockart & DeLong, 1988) to apply it to information systems for executives, confirming the applicability of Rockart and DeLong's eight original factors plus two additional ones. Nevertheless, they consider that, out of all the success factors, we will achieve success if we manage just three of them: support at both executive and operational levels; resources; and linking the system to the business objectives.

According to Pijpers, Bemelmans, Heemstra and van Montfort (2001), the perception of fun/enjoyment that senior executives may have when using an information system is an external variable that influences beliefs about, attitude to and use of systems.

Xu and Kaye (2002) analyse the support needs of executives, concluding that they need support from information specialists rather than technology specialists, the function of the former being to scan external information in the outside world, turn it into meaningful information and make it easily accessible to managers so that they can use it. Consequently, when EISs are designed and implemented, we must train the executives not only to use the system but also about what information they will find, systematically updated, analysed and formatted by information specialists before the executives use the system. These specialists must therefore be familiar with the culture of the executives; they must exploit and obtain the

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

vision of the executives and the knowledge to judge and interpret the information and make explicit that which must be shared among information specialists.

We must take into account the differences between expert and novice executive computer users, as shown by Hung (2003). Executives' skills affect system use; expert users require less time to reach a solution and view more screens when performing analytical tasks, whereas novices view more screens when performing more intuitive ones, and executives feel more useful when they use more powerful systems. Furthermore, expert users consider intuitive systems to be more useful than analytical ones, whereas the difference is not significant for novices.

Senior executives are not benefiting from the use of technologies (Seyal & Pijpers, 2004). Lack of commitment to the use of ICTs and their applications can be regarded as a threat to competitiveness. According to the authors there are several reasons accounting for impediments to ICT use: (1) senior executives have little time to play around with new technologies, (2) senior executives are reluctant to use the technology due to PC anxiety, and (3) senior executives lack skill and proficiency in ICT use, and moreover lack support staff to answer their queries. Some senior executives argue that they see no connection what ICTs do and their task as senior executives. The reaction to ICTs is even worse if they took no IT-related course during their college years.

Internationalisation has created the need to assess whether senior executives make strategic decisions differently depending on their origin. Martinsons and Davison (2007) analyse the differences among American, Japanese and Chinese executives, between whom they establish different decision styles; hence information technologies must be adapted to the different styles of their users.

5 Analysis and results

On the basis of the above literature review, we present the various studies in Table 1, separating: reasons against the use of computers and applications; reasons in favour of the use of computers and applications; and key factors to increase the use of computers and applications by senior executives. For each factor we indicate in parentheses whether they are related to: Senior Executives (SE), the System (S), the Project (P), or Other factors (O). This classification will then enable us to sort and aggregate them. For most factors their relationship with SE, S, P, and O is

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

clear, and when they can be related to more than one factor the most relevant is chosen. It is not necessary to state the justification for each factor, but by way of example, one of the reasons against computer use for Brady (1967) is "Lack of understanding of computer use", as can be seen in Table 1, and this has been related to Senior Executives, as it clearly depends on them. In turn, "Link system to business objectives", for example, as proposed by Poon and Wagner (2001), has been related to the Project, as it depends on the definition of each particular project, and so on for the rest of the factors.

Author	Reasons against use	Reasons in favour of use	Factors to increase use
Brady (1967)	Lack of understanding of computer use. (SE) A defensive attitude. (SE) Lack of development of applications. (S) Indecision on the part of executives in formally identifying the decision-making criteria they wanted to use. (SE) Executives' tendency to wait for other firms to invest and take the risk of being pioneers. (SE)		Stronger training in computer use. (SE) Passing of time. (O) Management changes due to staff movements. (O)
Rockart and Treacy (1982)		Availability of applications designed for executives' tasks. (S) Personalisation of applications. (S) Incremental projects. (P)	
Mawhinney and Lederer (1990)		Contribution to job performance. (SE) Level of competence with the system. (SE)	
Seeley and Targett (1997)	Reluctance to spend extra time learning applications other than spreadsheets. (SE) Older executives use a narrower range of applications. (SE)		
Drucker (1998)	System did not provide them with the necessary information. (P)		Need for systems to collect more external information. (P) Stronger ICT training for executives. (SE) System chiefs capable of attending to executives' demands. (P)
Seeley and Targett (1999)			Executives' perception of their role as managers. (SE) Modus operandi. (SE) Personality. (SE) System infrastructures. (P) Nature of the task. (SE) Organisational culture. (O)

Journal of Industrial Engineering and Management
doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

Poon and Wagner (2001)			Support at both executive and operational levels. (P) Available resources. (P) Linking the system to the business objectives. (P)
Pijpers, Bemelmans, Heemstra and van Montfort (2001)		Perception of fun or enjoyment in ICT use. (SE)	
Xu and Kaye (2002)			Support from information specialists. (P)
Hung (2003)			Need to adapt systems to executives' experience. (S)
Seyal and Pijpers (2004)	Little time to play around with new technologies. (SE) Reluctance to use the technology due to PC anxiety. (SE) Lack of skill and dexterity in ICT use. (SE) Lack of support staff to answer their queries. (P) No connection seen between what ICTs do and their task as executives. (SE)		
Martinsons and Davison (2007)			Adapt to the different styles of their users. (S)

Table 1. "Summary of reasons against, reasons in favour of, and factors to increase the use of computers and applications by senior executives".

The 37 reasons cited by various authors and studies and presented in Table 1 were each allocated to one of the following categories: Senior Executives, System, Project, or Others. Subsequently, with the object of reducing the number of factors, whenever possible they were grouped together taking into account those that are alike and had been cited in more than one of the studies involved. In the event of the factors being insufficiently alike they were maintained in different groups. Table 2 shows all the groups and each factor allocated within the new classification, which includes all the contributions of the various studies. For example, the factors grouped together owing to their relationship with the Project as "availability of resources" are: lack of support staff to answer their queries, support from information specialists, system chiefs capable of attending to executives' demands, available resources, and system infrastructures; each of these factors is clearly related to the availability of resources (both economic and personal) in a project. However, the factors grouped together under "resource availability" are not related to other project groups, i.e., they are not related to:

Journal of Industrial Engineering and Management
doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

"support from management", "incremental project" or "alignment". In the analysis we have taken into account each factor and its possible relationship with the rest. Those that were not related to any others have been kept apart to form a group of their own. This is the case, for example, with the tendency of executives to wait for other firms to invest and take the risk of being the first; this factor is not related to any of the other 36.

Relationship	Groups of factors	Factors
Senior Executives	ICT training	Lack of understanding of computer use. Stronger training in computer use. Reluctance to spend extra time learning applications other than spreadsheets. Stronger ICT training for executives. Little time to play around with new technologies.
	Competence in using the system	Level of competence with the system. Lack of skill and dexterity in ICT use.
	Age	Older executives use a narrower range of applications.
	Personality	Personality.
	Modus operandi	Modus operandi.
	Attitude to ICTs	Reluctance to use the technology due to PC anxiety. Perception of fun or enjoyment in ICT use. A defensive attitude. Executives' perception of their role as managers.
	Ability to identify decision-making criteria	Indecision on the part of executives in formally identifying the decision-making criteria they wanted to use.
	Contribution of ICTs	Nature of the task. No connection seen between what ICTs do and their task as executives. Contribution to job performance.
	Risk aversion against investing in ICTs	Executives' tendency to wait for other firms to invest and take the risk of being pioneers.
System	Functionality of the system	Personalisation of applications. Adapt to the different styles of their users. Need to adapt systems to executives' experience. Lack of development of applications.
	Specificity of the system	Availability of applications designed for executives' tasks.
Project	Support from management	Support at both executive and operational levels.
	Resource availability	Lack of support staff to answer their queries. Support from information specialists. System chiefs capable of attending to executives' demands. Available resources. System infrastructures.
	Incremental project	Incremental project.
	Alignment	Linking the system to the business objectives. System did not provide them with the necessary information. Need for systems to collect more external information.
Others	Other factors	Passing of time. Organisational culture. Management changes due to staff movements.

Table 2. "Relationship of factors with: Senior Executives, System, Project and Others".

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

Those factors that are not directly related to Senior Executives, the System or the Project have been grouped together in the category Others, and they have not been merged owing to their diversity. This is one of the limitations of the study.

6 Conclusions, implications and limitations

In this paper we report the results of empirical research through which we propose a framework to establish the main factors that might lead to an increase in ICT use by senior executives. We group these factors together into three categories: those related to the senior executive, to the system, and to the project. In the literature review, it is shown that none of the existing studies take the totality of the factors into account simultaneously. Thus the main contribution of the present study is the creation of the list of factors that affect the use of computers and applications by senior executives.

The creation of this list of factors has a practical research implication, namely to provide researchers with a common list of factors that they can use in their work (Cano Giner, Fernandez, Diaz Boladera, 2009). On the basis of the literature review, we represent the information in Table 1, making the various factors easier to understand and indicating the relationship each of them has with the Senior Executives, the System, the Project and Others. We then group the factors together within each of these categories, thus reducing the number of factors and forming a smaller group of categories that can facilitate research, as shown in Table 2. As the intermediate steps are displayed, researchers can check for themselves the appropriateness of the groupings.

A limitation of this research is that it should be confirmed by means of quantitative research that would allow us to test the validity of the proposed framework, and also to ascertain the relative importance of each factor.

References

Brady, R. H. (1967). Computers in top-level decision making. *Harvard Business Review*, 45(4): 67-76.

Buchanan, L., & O'Connell, A. (2006). A brief history of decision making. *Harvard Business Review*, 84(1): 32-41.

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

Cano Giner, J., Fernandez, V., & Díaz Boladeras, M. (2009). Framework for the analysis of executive information systems based on the perceived usefulness and the perceived ease of use. *Intangible Capital*, 5(4): 370-386
doi: 10.3926/ic.2009.v5n4.p370-386

Drucker, P.F. (1998). The next information revolution. *Forbes ASAP*, August 24, 47-58.

Houdeshel, G., & Watson, H. J. (1987). The Management Information and Decision Support (MIDS) system at Lockheed-Georgia. *MIS Quarterly*, 11(1): 127-140.
doi:10.2307/248834

Hung, S. Y. (2003). Expert versus novice use of the executive support systems: An empirical study. *Information & Management*, 40(3): 177-189.
doi:10.1016/S0378-7206(02)00003-4

Martinsons, M. G., & Davison, R. M. (2007). Strategic decision making and support systems: Comparing American, Japanese and Chinese management. *Decision Support Systems*, 43(1): 284-300.
doi:10.1016/j.dss.2006.10.005

Mawhinney, C. H., & Lederer, A. L. (1990). A study of personal-computer utilization by managers. *Information & Management*, 18(5): 243-253.
doi:10.1016/0378-7206(90)90026-E

Pijpers, G. G. M., Bemelmans, T. M. A., Heemstra, F. J., & van Montfort, K. A. G. M. (2001). Senior executives' use of information technology. *Information and Software Technology*, 43(15): 959-971.
doi:10.1016/S0950-5849(01)00197-5

Poon, P., & Wagner, C. (2001). Critical success factors revisited: Success and failure cases of information systems for senior executives. *Decision Support Systems*, 30(4): 393-418.
doi:10.1016/S0167-9236(00)00069-5

Rockart, J.F., & DeLong, D.W. (1988). *Executive Support Systems: The Emergence of Top Management Computer Use*. Illinois: Dow Jones-Irwin.

doi:10.3926/jiem.2011.v4n2.p326-338 JIEM, 2011 – 4(2): 326-338 – Online ISSN: 2013-0953
Print ISSN: 2013-8423

Rockart, J. F., & Treacy, M. E. (1982). The CEO goes on-line. *Harvard Business Review*, 60(1): 82-88.

Seeley, M., & Targett, D. (1999). Patterns of senior executives' personal use of computers. *Information & Management*, 35(6): 315-330. doi:10.1016/S0378-7206(99)00002-6

Seeley, M. E., & Targett, D. (1997). A senior executive end-user framework. *Information Systems Journal*, 7(4): 289-308. doi:10.1046/j.1365-2575.1997.00019.x

Seyal, A. H., & Pijpers, G. G. M. (2004). Senior government executives' use of the internet: A Bruneian scenario. *Behaviour & Information Technology*, 23(3): 197-210.

Xu, X. Z. M., & Kaye, G. R. (2002). Knowledge workers for information support: Executives' perceptions and problems. *Information Systems Management*, 19(1): 81-88.

Annex 4: Survey

Dear executive,

I would like to invite you to take part in a survey designed to improve our understanding of executives and their use of Executive Information Systems. I am a Lecturer in the Department of Information Systems Management at ESADE Business School (Universitat Ramon Llull), and this study is a part of the research I'm carrying out for my doctoral thesis.

As Britannica Academic Edition says "an information system is an integrated set of components for collecting, storing, processing, and communicating information" so in our study an Executive Information System is one kind of information system designed on executive needs and used by executives.

The aim of this survey is to understand and categorize the factors that executives feel can affect their use of Executive Information Systems and make it easier to manage these factors in both new projects as well as in organizations that already have these types of solutions in place.

This survey consists of three parts:

1. In this first section, you will have to answer a series of questions regarding the position you currently hold and your use of Executive Information Systems.
2. In the next section, you have to organize 94 cards into different groups as you see fit. However, the following restrictions apply: each card can only be included in one group; you cannot classify all the cards into a single group; and the individual cards cannot be individual groups. (The numbers appearing on the cards are only for their later processing.)
3. In the last part, you will have to evaluate 94 statements to indicate to what degree you would have used the Executive Information System depending on the different conditions.

This entire survey should take no more than 40 minutes of your time.

Your answers are anonymous and confidential. Do not include your name on your survey. In addition, the results are always presented in the aggregate, never individually. Your participation is also completely voluntary. Returning the survey implies that you consent to participate in this study. The results of the latter shall be presented at ESADE Business School (Universitat Ramon Llull) and published in professional journals.

Please feel free to contact me if you have any questions or doubts: (34) 629 128 126 or josepllluis.cano@esade.edu.

Thank you in advance for your time and consideration.

Josep Lluís Cano Giner
Lecturer, ESADE Department of Information Systems Management

Part 1 Instructions:

Please answer the questions by checking the correct response, for example:

Yes	No	I don't know

or by introducing your answer in the space provided

……*My answer*…..

EXECUTIVE INFORMATION SYSTEM USED

A1	Do you use a computer-based executive information system on your own?	Yes	No	I don't know
A2	Does this executive information system provide data in graphs, tables and text format?	Yes	No	I don't know
A3	Does this executive information system provide you internal and external information and data?	Yes	No	I don't know
A4	Does this executive information system provide you information in real time?	Yes	No	I don't know
A5	Is this executive information system's design based on your needs?	Yes	No	I don't know
A6	Did you need a few training sessions on how to use this executive information system?	Yes	No	I don't know
A7	Does this executive information system allow you to drill down from the aggregate information level to detailed information?	Yes	No	I don't know

If the last answer is 'No' or 'I don't know', go to question A8 below. If the answer is 'Yes', please go to question A11:

A11	Do you use the functionality enabling you to go from the aggregate information level to detailed information?	Yes	No	I don't know

A8	Does this executive information system provide analytical functionalities?	Yes	No	I don't know

If the last answer is 'No' or 'I don't know', go to question A9 below. If the answer is 'Yes', please answer question A12:

A12	Do you use these analytical functionalities?	Yes	No	I don't know

A9	Does this executive information system provide you tendency analysis?	Yes	No	I don't know

If the last answer is 'No' or 'I don't know', go to question A10. If the answer is 'Yes', please answer question A13:

A13	Do you use this tendency analysis?	Yes	No	I don't know

A10	Does this executive information system alert you about exception information?	Yes	No	I don't know

A14 On what vendor solution is the executive information system you use in your company based?

☐	Business Objects	☐	Qlikview
☐	Cognos	☐	Board
☐	Microstrategy	☐	SAS
☐	Oracle	☐	Information Builders
☐	Microsoft	☐	Excel
☐	Hyperion	☐	Other (please specify): ……..……

EXECUTIVE INFORMATION SYSTEM USER EXPERIENCE

B1 Did you work with other executive information systems prior to the system you currently use?

Yes	No	I don't know

B2 How often do you use this executive information system (indicate either per day, per week or per month)?

…….	times every day
……...	times every week
……...	times every month

B3	How many hours per week do you use this executive information system?	…….
B4	How long have you used this executive information system in your current job (in years)?	…….
B5	What percentage of this executive information system do you think you actually use?	…….
B6	How would you rate yourself as an user of this executive information systems (high or low)?	High / Low
B7	What is your level of satisfaction with the executive information system (from 0 - not satisfied to 10 - very satisfied)?	…….

PERSONAL INFORMATION

C1 What is your current job title? ……

C2 How old are you?

☐	between 25 and 34
☐	between 35 and 44
☐	between 45 and 54
☐	between 55 and 64
☐	above 65

C3 What is your gender?

Female	Male

C4 What is the highest level of formal education you have attained to date?

☐	High School diploma
☐	Bachelor's degree
☐	Master degree
☐	PhD degree

C5 In what area or department do you work?

- ☐ General Management
- ☐ Accounting or Finance
- ☐ Human Resources
- ☐ Information Systems
- ☐ Production or Purchasing
- ☐ Marketing or Sales
- ☐ Other (please specify): ……..……

C6 Are you concerned with the strategic direction of your organization's business? Yes / No

C7 How many years' work experience do you have? .....

C8 How long have you worked for your current firm (in years)? .....

C9 How long have you held your current position (in years)? .....

C10 What kind of information systems user do you think that you are?

☐ Beginner ☐ Intermediate ☐ Advanced ☐ Expert

COMPANY INFORMATION

D1 In what industry is your company?

- ☐ Telecommunications
- ☐ Aerospace & Defense
- ☐ Automotive
- ☐ Transportation
- ☐ Education
- ☐ Pharmaceutical
- ☐ Manufacturing
- ☐ Chemicals
- ☐ Financial Services
- ☐ Consumer Products/Retail
- ☐ Energy & Utilities
- ☐ Other (please specify): ……..……

D2 In what country do you work? .....

D3 How many employees does your company have?

- ☐ between 1 and 9 employees
- ☐ between 10 and 49 employees
- ☐ between 50 and 249 employees
- ☐ more than 250 employees

D4 What is your company's sales volume?

- ☐ less than €2 million
- ☐ between €2 and €10 million
- ☐ between €10 and €50 million
- ☐ more than €50 million

Part 2 Instructions

You will find 94 cards and some paper clips in the envelope provided. Each of these cards contains one sentence.

You should separate and classify the 94 cards into different groups which make sense for you.

However, the following restrictions apply:

- Each card can only be in one group.
- You cannot put all the cards into a single group.
- The individual cards cannot be independent groups.

Once you've classified all the cards, clip them together in their groups and put them back in the envelope provided.

Part 3 Instructions

Use the following scale (from much less to much more) to indicate to what degree you would have used the Executive Information System depending on the different conditions in the following 94 sentences.

1	2	3	4	5
Much less	Less	No much, no less	More	Much more

Please circle the number that represents what you would have done, for example:

1 2 (3) 4 5

1	If other executives had influenced you to use the executive information system …	1 2 3 4 5
2	If the executive information system had been easier to remember…	1 2 3 4 5
3	If the executive information system screens had been designed better …	1 2 3 4 5
4	If the quality of the executive information system information had been better …	1 2 3 4 5
5	If the executive group had been more innovative …	1 2 3 4 5
6	If the use of the executive information system had been a part of the organization's culture ...	1 2 3 4 5
7	If the executive information system had been easier to learn …	1 2 3 4 5
8	If the executive information system had included an information confirmation mechanism …	1 2 3 4 5
9	If you had been closer to sources of power …	1 2 3 4 5
10	If there had been a problem and you could have used the executive information system to focus on the issue, disregarding the details, …	1 2 3 4 5
11	If the executive information system could have been adapted to the different executive leadership styles …	1 2 3 4 5
12	If you had suffered from job insecurity ...	1 2 3 4 5
13	If the executive information system had included the information you needed …	1 2 3 4 5
14	If the executive information system had been more reliable …	1 2 3 4 5
15	If the executive information system had offered a greater wealth of information …	1 2 3 4 5
16	If the executive information system had included more external information ...	1 2 3 4 5
17	If you had been less defensive …	1 2 3 4 5

18	If someone had demonstrated the positive results obtained from using the executive information system …	1 2 3 4 5
19	If there had been organizational pressure to use the executive information system …	1 2 3 4 5
20	If the project had had more visibility …	1 2 3 4 5
21	If you had needed less time to find the information required …	1 2 3 4 5
22	If the executive information system and the business objectives had been better linked …	1 2 3 4 5
23	If the project's implementation process had been better…	1 2 3 4 5
24	If the project's implementation had been incremental …	1 2 3 4 5
25	If you had felt greater cultural affinity with the executive information system ...	1 2 3 4 5
26	If you had been more predisposed to using computers …	1 2 3 4 5
27	If the executive information system had had a drill-down function, enabling you to go from aggregated information to detailed data, …	1 2 3 4 5
28	If you had had support from information specialists …	1 2 3 4 5
29	If there had been institutional control over the executive information system's use ...	1 2 3 4 5
30	If the system's infrastructures had been better …	1 2 3 4 5
31	If the executive information system had been multidimensional in terms of functionality …	1 2 3 4 5
32	If it had been easy to interpret the information in the executive information system's graphs, tables, reports, etc. …	1 2 3 4 5
33	If the executive information system had had the same functionalities as Windows or the Internet …	1 2 3 4 5
34	If your ability to concentrate had been better …	1 2 3 4 5
35	If you had trusted the executive information system …	1 2 3 4 5
36	If resources had been available for the executive information system …	1 2 3 4 5
37	If you had perceived that the executive information system was less complex …	1 2 3 4 5
38	If it had been easier to know what information the executive information system contained …	1 2 3 4 5
39	If you had been better at using the executive information system …	1 2 3 4 5
40	If the designers had instilled a more favorable attitude among executives by involving them during the implementation project …	1 2 3 4 5
41	If it had been less difficult to use the executive information system …	1 2 3 4 5
42	If the organization had used the executive information system more …	1 2 3 4 5
43	If you had had more experience with the executive information system …	1 2 3 4 5
44	If you hadn't been reluctant to spend extra time learning how to use applications other than spreadsheets …	1 2 3 4 5
45	If you had been more computer literate …	1 2 3 4 5
46	If the executive information system had been better designed to suit your tasks …	1 2 3 4 5
47	If there had been external courses on how to use the executive information system …	1 2 3 4 5
48	If the use of the executive information system had been voluntary …	1 2 3 4 5
49	If you had had a better understanding of the use of computers …	1 2 3 4 5
50	If there had been back-end support for executive information system users …	1 2 3 4 5
51	If the executive information system had offered clear and precise help …	1 2 3 4 5
52	If you had participated in the executive information system's development …	1 2 3 4 5
53	If the executive information system could have been customized …	1 2 3 4 5
54	If the system graphics had been better …	1 2 3 4 5
55	If the executive information system had been more important …	1 2 3 4 5
56	If you had been involved in the executive information system's design …	1 2 3 4 5

57	If you had been trained on computer usage …	1 2 3 4 5
58	If you had had more time to play with and explore the executive information system …	1 2 3 4 5
59	If there had been organizational polices supporting the executive information system ...	1 2 3 4 5
60	If there had been no implementation gap …	1 2 3 4 5
61	If you had participated in the training program …	1 2 3 4 5
62	If there had been social pressure to use the executive information system …	1 2 3 4 5
63	If your computer skills had been better …	1 2 3 4 5
64	If your perception of your role as an executive had been different …	1 2 3 4 5
65	If the terminology used in the executive information system had been clearer …	1 2 3 4 5
66	If it had been easier to understand the information model used …	1 2 3 4 5
67	If you had been better able to innovate…	1 2 3 4 5
68	If management had been more supportive during the project's implementation …	1 2 3 4 5
69	If the executive information system had been more accurate …	1 2 3 4 5
70	If the developer had been more responsive …	1 2 3 4 5
71	If there had been greater political pressure …	1 2 3 4 5
72	If the executive information system had contributed more to your job performance …	1 2 3 4 5
73	If there had been internal training programs for the executive information system …	1 2 3 4 5
74	If it had been easier to access the executive information system …	1 2 3 4 5
75	If there had been organizational support on the executive information system …	1 2 3 4 5
76	If you had identified the decision-making criteria you wanted to use …	1 2 3 4 5
77	If other colleagues had had influence …	1 2 3 4 5
78	If it had been easier to browse the executive information system …	1 2 3 4 5
79	If the executive information system had included "What if" functionalities …	1 2 3 4 5
80	If the executive information system had been more attractive …	1 2 3 4 5
81	If the executive information system had needed less response time …	1 2 3 4 5
82	If access to the executive information system director had been easier ...	1 2 3 4 5
83	If you had been less anxious about using computers …	1 2 3 4 5
84	If the executive information system had offered greater security …	1 2 3 4 5
85	If the first screen had contained the most important information about all key areas …	1 2 3 4 5
86	If you had felt happier using the executive information system …	1 2 3 4 5
87	If you had participated during the implementation project …	1 2 3 4 5
88	If your colleagues had used the system more …	1 2 3 4 5
89	If the executive information system had had a "map-like function" in case you got lost …	1 2 3 4 5
90	If the executive information system had been compatible with other executive information systems …	1 2 3 4 5
91	If there had been conditions making it easier to access the executive information system …	1 2 3 4 5
92	If there had been fewer perceived risks during the project's implementation …	1 2 3 4 5
93	If you had known how the calculations were done (having the option to check them) …	1 2 3 4 5
94	If the executive information system information had been updated more often …	1 2 3 4 5

Thank you in advance for your help.