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

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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*.

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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

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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

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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

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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).

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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.

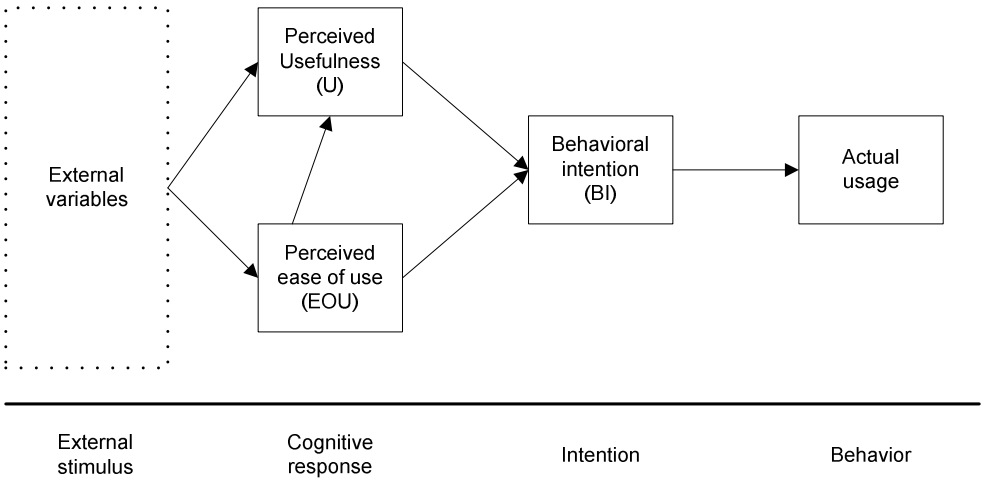

Figure 1. "Technology Acceptance Model (TAM)". Source: Davis et al., 1989

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

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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

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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

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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,

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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

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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.

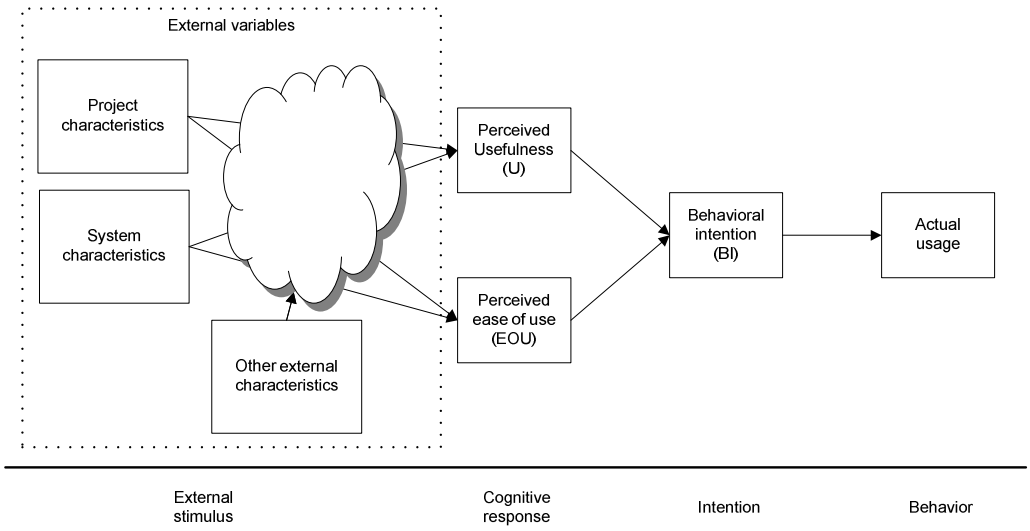

Figure 2. "Adapted Technology Acceptance Model". Source: authors

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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.

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