

A COMPARATIVE ANALYSIS OF EXECUTIVE INFORMATION SYSTEMS IN ORGANISATIONS IN SOUTH AFRICA AND SPAIN

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ABSTRACT

Executive Information Systems (EIS) grew out of the information needs of executives and are designed to serve the needs of users in strategic planning and decision-making. EIS are high risk information technology (IT) implementation projects. With the emergence of global information technologies, existing paradigms are being altered which are spawning new considerations for IT implementation. Web-based technologies are causing a revisit to existing IT implementation models, including those for EIS. The authors compare two recent survey studies of EIS implementation in well-established organisations in South Africa and Spain. From a comparative analysis, the authors report six identified similarities and three differences in EIS in these countries.

KEYWORDS

Executive Information Systems (EIS).

1. INTRODUCTION

Executive Information Systems (EIS) are computer-based systems that serve the needs of top executives (Turban *et al.*, 2004) and for making both strategic and tactical decisions (Salmeron *et al.*, 2001). An EIS is used by executives to extract, filter, compress and track critical data (Butler, 1992) and to allow seamless access to complex multi-dimensional models so that they can see their business at a glance (Harris, 2000). An effective way to evaluate the success of an EIS is to obtain opinions from the executive users (Monash University, 1996).

2. EXECUTIVE INFORMATION SYSTEMS

Definitions of EIS are varied and all identify the need for information that supports decisions about the business as the most important reason for the existence of EIS (Khan, 1996). In this paper EIS is defined as 'a computerized system that provides executives with easy access to internal and external information that is relevant to their critical success factors' (Watson *et al.*, 1997). While a definition is useful, a richer understanding is provided by describing the capabilities and characteristics of EIS.

Earlier studies described EIS capabilities which are focused on providing information which serves executive needs. Srivihok (1998) reports that these capabilities are concerned with both the quality of the system (*e.g.* user friendliness) and information quality (*e.g.* relevance). Sprague and Watson (1996) identify the following capabilities or characteristics of EIS: tailored to individual executive users; extract, filter,

compress and track critical data; provide online status access, trend analysis, exception reporting and 'drill down'; access and integrate a broad range of internal and external data; user-friendly and require little or no training to use; used directly by executives without intermediaries; and present graphical, tabular and/or textual information.

Other researchers suggest additional capabilities and characteristics of EIS: flexible and adaptable (Carlsson and Widmeyer, 1990); should contain tactical or strategic information that executives do not currently receive (Burkan, 1991); facilitate executives' activities in management such as scanning (see, for example, Müller *et al.* (1997) for a discussion on environmental scanning), communication and delegating (Westland and Walls, 1991); make executive work more effective and efficient (Friend, 1992); assist upper management to make more effective decisions (Warmouth and Yen, 1992; Chi and Turban, 1995); incorporate an historical 'data cube' and 'soft' information (Mallach, 1994), understanding a 'data cube' as a structure in which data is organised at the core of a multi-dimensional online analytical processing (OLAP) system (Ross, 2001), whereas 'soft' information includes opinions, ideas, predictions, attitudes, plans, *etc* (Watson *et al.*, 1996); provide support for electronic communications (Rainer and Watson, 1995); and enhanced relational and multi-dimensional analysis and presentation, friendly data access, user-friendly graphical interfaces, imaging, hypertext, Intranet access, Internet access and modelling (Turban *et al.*, 1999).

3. BACKGROUND TO COMPARATIVE STUDY

EIS flexibility should be considered in the development of an EIS in an organisation (Srivihok, 1998). Salmeron *et al.* (2001) reports that if this were not so, EIS would soon become a useless tool which would only deal with outdated problems and would therefore not contribute to decision-making. EIS should be flexible to support different classes of business data (*e.g.* external, internal, structured and unstructured) and different levels of users (*e.g.* executives and non executive users). Given these circumstances, some studies reveal the preponderance of an evolving approach (an ongoing growing EIS development and delivery cycle process) in the development methodology against the linear approach *i.e.* a highly structured linear process with sequential stages (Watson *et al.*, 1991; Allison, 1996; Kirlidog, 1997; Park *et al.*, 1997; Roldán and Leal, 2003).

EIS are high-risk information technology (IT) investments (Glover *et al.*, 1992). With the emergence of global IT, existing paradigms are being altered which are spawning new considerations for successful IT implementation (Averweg and Erwin, 2000). Web-based technologies are causing a revisit to existing IT implementation models, including EIS. The Web is 'a perfect medium' for deploying decision support and EIS capabilities on a global basis (Turban *et al.*, 1999).

The authors compare two recent studies of EIS implementations in well-established organisations in South Africa and Spain. For a detailed discussion of these EIS surveys in organisations in (1) South Africa, see Averweg (2002); and (2) Spain, see Roldán (2000) and Roldán and Leal (2003). For brevity in this paper, these studies are referred to as the Averweg (2002) study and Roldán and Leal (2003) study respectively. Tables 1 to 13 contained in this paper were extracted from the Averweg (2002), Roldán (2000) and Roldán and Leal (2003) studies and refer to the EIS surveys conducted in well-established organisations in South Africa and Spain correspondingly.

4. COMPARATIVE ANALYSIS OF AVERWEG (2002) AND ROLDÁN AND LEAL (2003) STUDIES

Organisations participating in the Averweg (2002) study belong primarily to the manufacturing (22,6%) and banking/financial services (19,5%) sectors. See Table 1. The prominence of these two sectors is reported in the Roldán and Leal (2003) study. The corresponding Spanish activity sector percentages are manufacturing (37,1%) and banking/financial services (24,3%).

The number of permanent employees in organisations in the Averweg (2002) study is given in Table 2. From Table 2, 20 (64,6%) of these organisations had more than 500 employees. This percentage compares favourably with the Spanish EIS survey percentage of 71,0% (Roldán and Leal, 2003).

Table 1. Activity sectors of organisations. Frequency and percentage

	South Africa (N=31)	Spain (N=70)
Manufacturing	7 (22,6%)	26 (37,1%)
Banking/Financial services	6 (19,5%)	17 (24,3%)
Retailing	5 (16,1%)	6 (8,6%)
Logistics	3 (9,7%)	6 (8,6%)
Firm services	4 (12,9%)	1 (1,4%)
Government or quasi-government	2 (6,4%)	6 (8,6%)
Health Industry	1 (3,2%)	2 (2,8%)
Water, gas, electrical power distribution and production	2 (6,4%)	3 (4,3%)
Social organisations	1(3,2%)	3 (4,3%)

Table 2. Number of permanent employees in organisations. Frequency and percentage

	South Africa (N=31)	Spain (N=69)
More than 5,001 employees	6 (19,5%)	12 (17,4%)
Between 2,001 and 5,000 employees	5 (16,1%)	9 (13,0%)
Between 501 and 2,000 employees	9 (29,0%)	28 (40,6%)
Between 251 and 500 employees	5 (16,1%)	12 (17,4%)
Between 51 and 250 employees	5 (16,1%)	6 (8,7%)
Less than 51 employees	1 (3,2%)	2 (2,9%)

The classification of organisations surveyed in the Averweg (2002) study is given in Table 3. Table 3 suggests that the existence of EIS in organisations is not limited to a single organisational classification. As EIS differ considerably in scope and purpose ‘the primary purpose of the system will change from one organization to another’ (Roldán and Leal, 2003).

Table 3. Classification of organisations. Frequency and percentage

	South Africa (N=31)
Public listed	11 (35,5%)
Public non listed	3 (9,7%)
Government or quasi-government body	6 (19,3%)
Foreign enterprise	2 (6,5%)
Private company	9 (29,0%)

Roldán and Leal (2003) surveyed organisations whose EIS were ‘operative or in an implementation stage sufficiently advanced’. The current (*i.e.* during the interview period) EIS situation in the respondent’s organisation in the Averweg (2002) study is given in Table 4. From Table 4, one EIS implementation failure was reported by a respondent. This failure was ascribed to the most recent EIS implementation.

Table 4. Current EIS situation in organisations. Frequency and percentage

	South Africa (N=31)	Spain (N=70)
Based on the evaluation, the EIS has been accepted and is under development and implementation	3 (9,7%)	6 (8,6%)
The EIS is operational and in use by executives/business end-users	27 (87,1%)	64 (91,4%)
EIS failure (where the latest EIS implementation has been successful)	1 (3,2%)	0 (0,0%)

From the twenty-seven operational EIS and in use by executives/business end-users (see Table 4), the time taken before EIS was in use by executives/business end users in the Averweg (2002) study is given in Table 5. Two respondents were not able to report the time taken before the EIS was in use by executives/business end-users. They stated ‘EIS in use before I joined the company’. Their null responses are not included in Table 5.

From Table 5, the average time taken before the EIS was in use by executives and business end-users in organisations in South Africa is 9,01 months. This compares favourably with the Roldán and Leal (2003)

study mean of 8,53 months. Salmeron *et al.* (2001) report that the development of an EIS (in Spain) usually takes 6-12 months. These means should be considered long term when compared with previous studies: 3,4 months in the USA (Watson *et al.*, 1991; Watson *et al.*, 1992a) and six months in South Korea (Park *et al.*, 1997). This situation could negatively affect the users' acceptance of the system (Young and Watson, 1995).

Table 5. Time taken before EIS was in use by executives/business end-users. Frequency and percentage

	South Africa (N=25)	Spain (N=68)
2 months or less	6 (24,0%)	5 (7,4%)
3 months	3 (12,0%)	5 (7,4%)
4 months	3 (12,0%)	5 (7,4%)
5 months	1 (4,0%)	2 (2,9%)
6 months	2 (8,0%)	14 (20,6%)
7 months	0 (0,0%)	3 (4,4%)
8 months	2 (8,0%)	5 (7,4%)
9 months	0 (0,0%)	2 (2,9%)
10 months	0 (0,0%)	2 (2,9%)
12 months	3 (12,0%)	18 (26,5%)
14 months	0 (0,0%)	1 (1,5%)
16 months	1 (4,0%)	1 (1,5%)
18 months	1 (4,0%)	4 (5,9%)
24 months	2 (8,0%)	1 (1,5%)
36 months	1 (4,0%)	0 (0,0%)

A rank descending order of applications for which EIS is used in organisations in the Averweg (2002) study is given in Table 6.

Table 6. Rank descending applications for which EIS is used. Frequency and percentage (multiple answer question)

	South Africa (N=31)
Access to projected trends of the organisation	23 (74,2%)
Access to current status information	22 (71,0%)
Performing personal analysis	16 (51,6%)
Querying corporate and external data bases	16 (51,6%)
Office automation activities	5 (16,1%)
Measuring Key Performance Indicators (KPIs)	1 (3,2%)

Research has found that the accessibility of information is more important than its quality in predicting use (O'Reilly, 1982). Access to updated online information is a basic characteristic of EIS (Houdeshel and Watson, 1987; Martin *et al.*, 1999).

The EIS user statistics for organisations surveyed in the Averweg (2002) study and Roldán and Leal (2003) study are given in Table 7. The mode and mean of EIS users per organisation in both samples are identical.

Table 7. EIS users in organisations surveyed

	South Africa (N=31)	Spain (N=67)
Minimum number of EIS users reported	2	3
Maximum number of EIS users reported	700	1800
Mode	20	20
Median	20	20
Mean	50	75,93
Standard Deviation	126	251,13

Roldán and Leal (2003) report that 'the average number of users in all organisations studied is 75.93 persons'. This figure is significantly higher than the first author's mean of 50 (N=31) in Table 8. A possible explanation for this is that in the Spanish survey, three organisations surveyed each had more than 400 users. One of these three organisations had a total of 1800 EIS users. In the Averweg (2002) study the largest number of reported EIS users in one organisation was 700. Roldán and Leal (2003) suggest that it would

therefore be more appropriate to take into account the mode and median values. They report 'the number of 20 users as a measure of the central trend'. The mode and median values correspond exactly to the South African study results given in Table 7.

The hierarchical employee levels where EIS is used in organisations surveyed is given in Table 8. From Table 8, middle managers show higher EIS use levels (80,6%) than top managers (Chief Executive Officer (45,2%), Managing Director (58,1%) and Top functional manager (74,2%)). This Middle manager use level (80,6%) is higher than the Roldán and Leal (2003) study of 68,6%. While Roldán and Leal (2003) report a 'close similarity' between EIS use by middle managers (68,6%) and EIS use by managing directors (70,0%), this similarity is not evidenced by the Averweg (2002) study in Table 8. There is a significant use difference between these two hierarchical levels. Furthermore Roldán and Leal (2003) report that '21.4% of organizations declare that they have other users', which could be classified as knowledge workers and analysts. Knowledge workers include engineers, financial and marketing analysts, production planners, lawyers and accountants (Turban *et al.*, 2004).

Table 8. Hierarchical employee levels where EIS is used in organisations. Freq. & percentage (multiple answer question)

	South Africa (N=31)	Spain (N=70)
Chairperson	0 (0,0%)	14 (20,0%)
Chief Executive Officer	14 (45,2%)	20 (28,6%)
Managing Director	18 (58,1%)	49 (70,0%)
Top functional manager	23 (74,2%)	62 (88,6%)
Middle manager	25 (80,6%)	48 (68,6%)
Other (e.g. business end-user, financial consultant, etc)	13 (41,9%)	15 (21,4%)

From Table 8, 41,9% of business end-users and financial consultants in organisations surveyed in South Africa fall below the Middle manager hierarchical level. This percentage of Other EIS users is significantly higher than the Roldán and Leal (2003) survey percentage of 21,4%. This tends to suggest that the degree of EIS diffusion to lower organisational hierarchical levels and use by these levels in organisations surveyed in South Africa is significantly higher than experienced by organisations surveyed in Spain. EIS are becoming less strictly defined to support professional decision-makers throughout the organisation (Turban and Aronson, 1998).

The different types of information included in an EIS in an organisation is given in Table 9. From Table 9, for organisations surveyed in South Africa, financial information (90,3%) appears as the most important item followed by business/commercial sales (74,2%) and then strategic planning (35,5%). In the Roldán and Leal (2003) study, the three highest ranking types of information held by an EIS in an organisation are business/commercial sales information (82,9%), financial information (65,7%) and production information (55,7%). While previous research studies agree in presenting these three types of information (sales, financial and production) as the most relevant ones (Thodenius, 1995; Allison, 1996; Kirlidog, 1997) the Averweg (2002) study partially support these findings with Business/Commercial Sales (74,2%) and Finance (90,3%) types of information. Holding strategic planning information in EIS in organisations in South Africa appears to have a higher importance than holding production information.

Table 9. Rank descending types of information included in EIS. Frequency and percentage (multiple answer question)

	South Africa (N=31)	Spain (N=70)
Finance	28 (90,3%)	46 (65,7%)
Business/commercial sales	23 (74,2%)	58 (82,9%)
Strategic planning	11 (35,5%)	10 (14,3%)
Inventory management/suppliers	10 (32,3%)	14 (20,0%)
Human resources	9 (29,0%)	31 (44,3%)
Production	8 (25,8%)	39 (55,7%)
Quality	7 (22,6%)	22 (31,4%)
'Soft' information	4 (12,9%)	25 (35,7%)
Trade/industry	4 (12,9%)	14 (20,0%)
Competitors	3 (9,7%)	16 (22,9%)
External news services	1 (3,2%)	9 (12,9%)
Stock exchange prices	1 (3,2%)	5 (7,1%)

Watson *et al.* (1996) recognise that executives require 'soft' information (often provided informally) for decision-making. Soft information is 'fuzzy, unofficial, intuitive, subjective, nebulous, implied, and vague'. Watson *et al.* (1996) found that soft information was used in most EIS but the Averweg (2002) study (12,9%) does not support this. One possible explanation is that it is often policy not to allow unsubstantiated rumours into IS without a reference to a source and tagged by the individual entering the information (Turban and Aronson, 1998).

From Table 10 it can be observed that the information that appears predominantly in EIS has an internal characteristic (Preedy, 1990). External information obtains low response levels: Trade/industry (12,9%), external news services (3,2%), competitors (9,7%) and stock exchange prices (3,2%). Roldán and Leal (2003) report similar low response levels.. Other studies agree in presenting this scenario (Allison, 1996; Kirlidog, 1997, Salmeron, 2002; Thodenius, 1996). According to Xu *et al.* (2003), this internal orientation with low response level for external information is the main reason for dissatisfaction with EIS.

Considering the hard/soft information continuum proposed by Watson *et al.* (1996), in organisations surveyed in Spain, Roldán and Leal (2003) observe those types of qualitative information more quoted are included in a halfway house between hard and soft information: predictions (52,0%) and explanations (48,0%) (Table 10). Roldán and Leal (2003) emphasise the absence of cases for the soft information extreme of the continuum (ie. rumours, gossip and hearsay) and suggest some explanations for this situation: (1) this kind of information can be considered too sensitive; (2) it can jeopardise competitive plans; and (3) it could expose the organisation to legal risks (Watson *et al.*, 1992b).

Table 10. Types of soft information included in EIS. Frequency and percentage (multiple answer question)

	Spain (N=25)
Predictions, speculations, forecasts, estimates	13 (52,0%)
Explanations, justifications, assessments, interpretations	12 (48,0%)
News reports, industry trends, external survey data	6 (24,0%)
Schedules, formal plans	5 (20,0%)
Opinions, feelings, ideas	1 (4,0%)
Rumours, gossip, hearsay	0 (0,0%)
Other	3 (12,0%)

How information is held by EIS in an organisation is given in Table 11. From Table 11, information is generally presented by products (71,0%), operational/functional areas (64,5%) and geographical areas (58,1%). Roldán and Leal (2003) report similar findings for operational/ functional areas (62,9%), products (61,4%) and geographic areas (52,9%). Roldán and Leal (2003) note that 'information according to processes ranks quite low, existing in only 20% of participating entities'. From Table 11 there is a striking commonality with the Averweg (2002) study of 19,4%. This situation was highlighted by Wetherbe (1991) as one of the traditional IS problems for top managers *i.e.* these systems are considered as functional systems rather than being considered as systems crossing functions.

Table 11. How information is held by EIS in organisations. Frequency and percentage (multiple answer question)

	South Africa (N=31)	Spain (N=70)
By products	22 (71,0%)	43 (61,4%)
By operational/functional areas	20 (64,5%)	44 (62,9%)
By geographic areas	18 (58,1%)	37 (52,9%)
By key performance areas	14 (45,2%)	33 (47,1%)
By company	11 (35,5%)	not available
By strategic business units	10 (32,3%)	37 (52,9%)
By processes	6 (19,4%)	14 (20,0%)
By projects	5 (16,1%)	11 (15,7%)
By customers	1 (3,2%)	0 (0,0%)

The different types of sources of information that support an EIS in an organisation are given in Table 12. One of the capabilities or characteristics of EIS is the filtering, organisation and consolidation of multiple data sources. This quantitative data stems from corporate databases (80,6%) and operational databases (64,5%).

Table 12. Sources of information that support EIS in organisations. Frequency and percentage (multiple answer question)

	South Africa (N=31)	Spain (N=70)
Corporate data bases	25 (80,6%)	61 (87,1%)
Operational data bases	20 (64,5%)	29 (41,4%)
Individuals	12 (38,7%)	23 (32,9%)
External databases	8 (25,8%)	19 (27,1%)
Documents or reports	7 (22,6%)	24 (34,3%)
Internet, Intranet or Extranet	5 (16,1%)	2 (2,9%) (only Internet)

Table 9 reflects that the information that appears predominantly in EIS has an internal characteristic. Table 12 shows that a significant majority of the information came from internal sources. External sources have a low presence: external databases (25,8%) and Internet, Intranet or Extranet (16,1%). This trend towards internal sources supports the results obtained in previous research studies (Watson *et al.*, 1991; Watson *et al.*, 1992a; Kirlidog, 1997; Basu *et al.*, 2000; Roldán and Leal, 2003; Xu *et al.*, 2003). In the opinion of Salmeron *et al.* (2001) 'the extent to which information coming from the environment is included in the EIS of Spanish big businesses should reach higher figures, due to the fact that all elements that currently form economy are interrelated'. Given the presence of Web-based technologies and from Table 12 it is therefore somewhat surprising that the Internet, Intranet and Extranet rank as the lowest source of information which support an EIS in organisations in the Averweg (2002) and Roldán and Leal (2003) studies. For a discussion of the impact of Web-based technologies on EIS implementation in organisations in South Africa, see Averweg *et al.* (2003).

The approach taken for EIS development is given in Table 13. Three organisations in the Averweg (2002) study gave more than one response. In South Africa, in-house development with assistance from the vendor (38,7%) was the most common approach taken.

Table 13. Approaches taken for EIS development in organisations. Frequency and percentage

	South Africa (N=31)	Spain (N=70)
In-house development with assistance from vendor	12 (38,7%)	not available
In-house development with critical EIS features developed initially and optional features added over time, using existing or commercially purchased software tools	9 (29,0%)	33 (47,1%)
Fully developed by vendor	7 (22,6%)	33 (47,1%)
In-house development using existing software tools	6 (19,4%)	4 (5,7%)

Roldán and Leal (2003) report a 'low number of cases in which the systems have been developed with software produced by the organization itself (5,7%)'. In the Averweg (2002) study, in house development using existing software tools is somewhat higher (19,4%). A possible explanation is that some organisations surveyed may not yet have migrated from their first (in-house developed) EIS. Roldán and Leal (2003) report in house development with assistance from the vendor (47,1%) as the most common approach taken in organisations surveyed in Spain. From Table 13, it can be seen that while this approach is taken by organisations surveyed in South Africa the occurrence is slightly less. On the other hand, Roldán and Leal (2003) highlight that 78,3% of the development process cases was performed with the help of external support, either from software vendors (27,5%), from external consultants (26,1%), or from both (24,6%).

5. CONCLUSION

In summary, the authors identify seven parallelisms in the two EIS studies conducted in South Africa and Spain. The similarities are: (1) the activity sectors of organisations belong primarily to the manufacturing and financial services sectors; (2) the average time take before an EIS was in use by executives and business end-users is slightly less than nine months; (3) the mode and median of executive and business end-users in organisations surveyed were twenty; (4) external information (*e.g.* trade/industry, external news services, competitors and stock exchange prices) in EIS have low internal characteristics; (5) there are similar trends in how information (*e.g.* by products, operational areas and geographical areas) is held by EIS in an organisation; and (6) there is a strong usage preference for commercially purchased EIS software tools.

The three identified differences in the two EIS studies are: (1) the degree of EIS diffusion to lower organisational hierarchical levels and use by these levels is significantly higher than experienced by organisations in Spain; (2) holding strategic planning information in organisations in South Africa appears to have higher importance than holding production information; and (3) EIS in-house development with assistance from the vendor occurs more frequently in organisations in Spain than in South Africa.

New Web-based architectures may replace old architectures or they may integrate legacy systems into their structure in organisations. From this study it is evident that EIS in South Africa and Spain are in a state of flux. As Turban (2001) notes 'EIS is going through a major change'. As users need systems that provide access to diverse types of information, there is therefore both scope and need for continued research in the area of future EIS implementation in these countries.

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