A Framework for the Development and Use of Executive Information Systems

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Abstract

Increasing amounts of money are being invested by organisations in Executive Information Systems (EISs). However, EISs development projects incur risks. The status of the end-user population of these systems and their informational requirements present a set of unique and difficult problems that need to be overcome. The eventual success of this kind of systems is affected by various factors during the development process and especially during the use of the system. To study these factors we need to examine EISs usage separately from the rest of the development cycle. To do that effectively we need to have a structured framework, to classify the various components involved in development and use and go on to highlight the relations between them. This paper proposes such a development framework for Executive Information Systems.

1 Introduction

Executive Information Systems (EISs) are computerised information systems designed to be operated directly by senior executive managers without the need of intermediaries' [1]. They aim to provide fast and easy access to information from a variety of sources, both internal and external to the organisation. They are easily customisable and can be tailored to the needs and preferences of the individual executive using it. Since the term was first introduced in [2], the trend of senior management having direct access to computers has grown and EISs have become a significant area of business computing.

An indication of this significance, are the increasing amounts of money invested by organisations in EISs development projects and the subsequent operation of these systems [3], [4]. EISs are gradually becoming an affordable option for a larger number of organisations. However, despite a definite trend of decreasing EIS building block prices, the development costs of an Executive Information System, are still relatively high [5]. These high costs of development of EISs [6], [4] in conjunction with the many factors that can influence their success, mean that EISs development is a high-risk undertaking for many organisations.

In the literature, very few EISs failures are documented[1], but the multitude of articles of prescriptive nature, suggests that these are not an uncommon phenomenon [7]. The concept of failure in the area of information systems however, is generally ill-defined [8]. Many researchers consider failure as evident needing no further clarification. Lyytinen and Hirschheim in [8], cite work discussing situations where Information Systems have been found to fail. Examples include: (a) when the potential benefits of the system are not realised [9]; (b) when the system is not used [10] and (c) when there is substantial user resistance [11]. Lyytinen and Hirschheim put forward the concept of expectation failure, which integrates all these types of failure. Expectation failure describes the notion of identifying a system failure when the system is unable to fulfil one of its stakeholder groups' expectations.

Moreover, there is no clear agreement concerning the most significant factors contributing to the success of an EIS implementation project [12]. It is however agreed that for an EIS, success or failure to a considerable extent depends on the way the development process is managed [5]. For an EIS, the most important phase in the development cycle is the use of the system. The uniqueness and idiosyncrasies of the user population, bring forth particular constraints for EISs, that can play a major role in the overall success of the system. In other words, success for an EIS is affected by factors during development, especially during the use of the system. For this reason, the use of EISs needs to be examined separately

[1] An example of such a case would be: L. Volonino and S. Robinson: *"Experiences at Marine Midland Bank." N. A.* Journal of Information Technology. Vol. 2., No. 2, 1991.

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from the rest of the development process.

We need to be aware of the various factors that could potentially affect the success of the system during development in order to ensure a minimal risk of failure. The most effective way to gain such an awareness is by having a structured approach to facilitate the study of these factors. This is provided by the construction of a suitable development framework for the classification of relevant issues. Such a development framework is "helpful in organising a complex subject, identifying the relationships between the parts and revealing the areas where further developments will be required" [13].

2 Four Frameworks for EISs development

As part of research done in both the academic and professional communities, a number of frameworks describing the EISs development process have emerged. Four such frameworks will be briefly reviewed here to determine their strengths and weaknesses in identifying and classifying elements of EISs development and usage that can influence success. Once determined, the useful features of each framework, can be combined in a single framework which can serve as the foundation for a more complete study of the factors associated with the success of an EIS.

The first of these frameworks is ESPRIT. This is based on the installation of a commercial EIS package. It was developed after experience gained from installing *Resolve*[2] in what were considered successful EIS projects [14]. It takes the form of a detailed sequential approach, featuring an evolutionary prototyping method, starting with an evaluation of the consultancy team and following on to other stages of development up until installation of the final system and training of the users. The framework goes into a considerable amount of detail but despite that, not much emphasis is placed on the methods of extracting the information requirements for the system, no relations to other procedures or systems operational in the organisation are made explicit. Moreover, no time considerations are taken into account. Furthermore, since it is specific to the installation of Resolve, no reference is made to aspects relating to any attributes of the resulting system that could affect its successful usage.

The second framework is put forward by Watson, Rainer and Koh in [15]. It originated as a way of classifying the results of a study on EISs practices conducted in the US in 1988. It consists of three components. The first, is a structural perspective of the elements involved in an EISs development project. The second part considers the development process in more detail and the third looks into issues relating to the user-system dialogue. Although this framework makes the distinction between the development process and system usage, the two are kept separate from the part that describes the structure of the process. Consequently, despite the interesting results that emerge from the study this framework supports, the relationships between the three parts of the framework are not considered in much detail.

The third framework is proposed by Millet et al. [3], and approaches EISs development from yet another perspective. It looks into aspects of timing and decisional maturity in organisations, and the transition path followed to develop an EIS from an MIS infrastructure. Although it presents an interesting and useful view of the process, the level of detail that it goes into is not very high. The focus of this framework is not on features of development at an individual's level but rather on an organisational-wide level. This perspective, although not very appropriate to the level of detail of this research, helps highlight issues that are of importance. The relations of EISs with other organisational systems and time considerations are important features of EISs development that this framework addresses.

The need for research focusing on social and organisational problems has led to the use of Anthony Giddens' structuration theory in relation to information systems. The final framework reviewed here is an application of structuration theory in the area of information systems. It is put forward by Orlikowski and Robey in [16] and tries to interpret social processes that go on during the development of an information system. The framework has been used for the analysis and interpretation of the installation of an EIS [17]. It provides an integrated, coherent way of linking the various elements of EISs development to human action. However, there are inherent limitations associated with attempting to model social processes specific to each individual situation. Although this research will not go into any great depth in exploring

[2] Resolve is a commercial EIS package marketed by Metapraxis.

the interpretation of social relations in the context of EISs development, this framework is important in indicating that there are relations between the various groups of people involved in EISs development and use.

3 The PAS framework

We can see from above that no single framework describes EISs development and use adequately. It has to be stressed that the deficiencies identified for each framework are only with respect to the purpose of this research. These are inevitable since they are inherent from the different perspective each framework adopts and the original purpose for which each framework was proposed. However, despite the shortcomings identified above, each framework displays a number of features that are useful in describing EISs development and use. We now go on to propose an alternative framework which attempts to integrate most of these useful features and at the same time overcome the shortcomings of each individual framework. Such a framework will constitute a useful tool for a coherent classification for further analysis of elements involved in developing and using an EIS.

The elements making up the framework can be summarised in three words: PEOPLE, ACTIVITIES and SYSTEMS (PAS). These elements form the main components of the framework. They are elements within an organisation, which have an effect on and describe EISs development and usage. The relation between the three components is shown in figure 1.

The framework can be described using set theory. Each of the three main components, can be considered to be sets containing elements present in an organisation during systems development. These three sets are:

P = Set of People in an organisation.

A = Set of Activities taking place.

S = Set of Systems present in the organisation.

In addition, the universal set represents the environment the organisation has to operate in.

e = Organisational Environment

The three main components intersect, giving rise to three new areas that divide the each of the sets into a number of mutually disjoined subsets. This structure is illustrated in the following diagram:

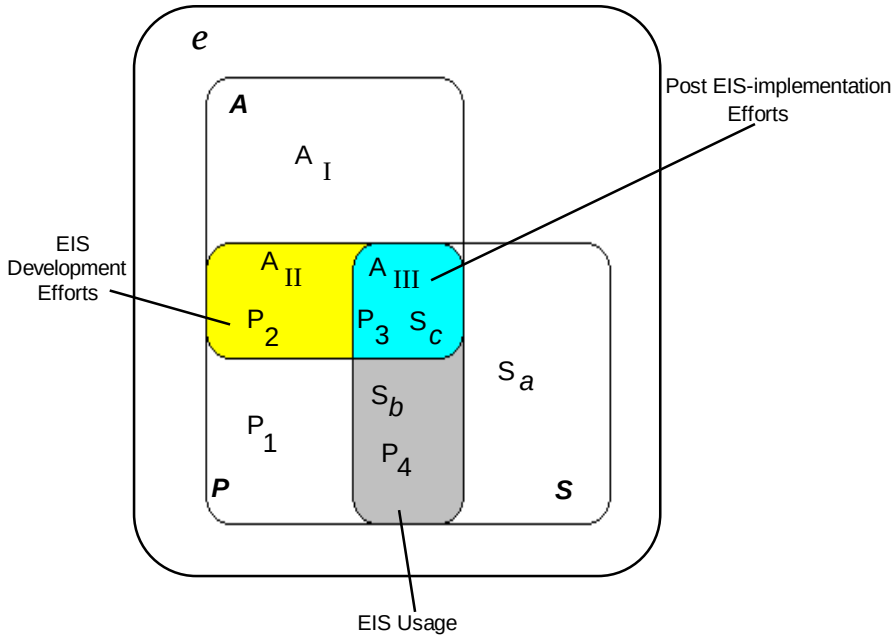

Fig. 1. The PAS framework for EISs development and use.

3.1 Components of PAS

a. People.

The first and most important component of the framework is *People*. During an EISs development project and the system's subsequent usage, people are the main element that determines the success of the system. Success does not only depend on people who are involved directly with the system [5]. Other people not involved in the system might also be stakeholders in the system's success. It is therefore reasonable to assume that factors like organisational politics, play an important role in the success of EISs. Examples of groups of people who might not be involved directly with either the development or the use of the system, and yet could influence its success include: people whose information the system does not use and executives who do not have access to the system. If these groups of people are viewed as stakeholders of the system, the consistency of the model with the concept of expectation failure can be demonstrated.

According to the framework, people within an organisation can be classified according to their membership in one of the four mutually disjoined subsets making up the set of people. These four subsets are:

P_1 = Set of People in the organisation that are not involved in EISs development activities, and are not users of the resulting EIS. This area is represented by:

$$P - ((P \cap S) \cup (P \cap A))$$

or using the distributive law,

$$P - (P \cap (S \cup A))$$

P_2 = People involved in the development process, but are not users of the system. This subset is represented by the area defined by:

$$(P \cap A) - (P \cap S \cap A)$$

P_3 = People actively involved in the development of the system and are also users of the system. This subset is represented by the area:

$$P \cap A \cap S$$

P_4 = People not involved in the development process but are users of the system. This subset is represented by:

$$(P \cap S) - (P \cap S \cap A)$$

Various people outside the boundaries of the organisation can also affect the success of these systems. These are discussed in the section about the environment in which the organisation has to operate below.

b. Activities.

Information systems development can be viewed as a project. For a project to be completed a set of activities need to be undertaken. The second part of the framework includes *activities* or procedures that typically take place in an organisation. Using the same rationale as for People involved with EISs, there are activities that might be directed specifically towards EISs development and others that go on in the organisation but affect EISs development indirectly. All activities can be either formal or informal in nature and are classified in three subsets:

A_I = This subset represents organisational activities not directly related to EISs which could nevertheless influence the development or use of EISs. This subset is represented by the area defined by:

$$A - (P \cap A)$$

A_{II} = This subset represents EISs development efforts. These are the activities that directly contribute towards the development of an EIS. This is the area represented by the intersection of the set of activities with the set of people and can be defined as:

$$(P \cap A) - (P \cap A \cap S)$$

A_{III} = This subset of activities represents Post-implementation efforts. These are the activities that take place to expand or enhance the initial EIS application.

$$(P \cap A \cap S)$$

c. Systems.

The last main element of the framework is *Systems*. This comprises any information systems that the organisation utilises to carry out its operations. This element of the framework, as noted by Millet et al. is important since the installation of EISs is usually a transition from other forms of management reporting systems. The existing infrastructure can place limitations and constraints on EISs and influence the success by which these systems are employed. According to the diagram various organisational systems can be categorised as follows:

S_a = Various other systems operational in the organisation. These systems are represented by the area defined by:

$$S - (P \cap S)$$

S_b = This subset of the systems in the organisation represents Executive Information Systems applications operational in the organisation. This area is represented by:

$$(P \cap S) - (P \cap A \cap S)$$

S_c = This subset of systems includes enhancements on, or expansions to the initial EIS implementation. This area can be described by the intersection of the three main components of the framework, i.e.:

$$(P \cap A \cap S)$$

d. The Environment and Time.

An integral part of the framework that completes the view of how EIS are developed and used is the *Environment* the organisation operates in. This is important, since there are elements in the environment that can influence the first three components in the framework and can affect the success with which EISs are developed and used. These could be either various people or legal entities that encounter the organisation, or be in the form of environmental constraints affecting the organisation.

A time dimension for each activity is also an important consideration. For reasons of clarity, this was not shown on the diagram above. The assumption is made that EIS development follows a linear time pattern. In other words, EIS development efforts take place before EIS usage, and post EIS-implementation efforts such as enhancements to the EIS, happen after EIS development and use.

3.2. Features of the Framework.

Each area of interest is illustrated by a shaded region on the diagram.

a. EISs Development Efforts.

As mentioned earlier, EISs development can be viewed as a project. A set of activities are undertaken by people making use of resources to reach the goal of the project, which in this case is the development of an EIS. The intersection between the sets of People and Activities, illustrated on the diagram by the shaded region, represents EIS development efforts. People actively involved in EIS development are within the shaded area. Other people, not be involved in development, but could still influence the successful development of the EIS are in the area that is labelled 'P_1' on the diagram of the model. Similarly activities directed towards EISs development are within the shaded area, and other activities that could affect the success of the system are found in the area labelled 'A_I'. People, activities and other factors that could also affect the development process and therefore the success of the system are not restricted within the organisation but could originate in the environment the organisation has to operate in.

b. EIS Usage.

The context for the various issues relating to the use of an EIS is provided by the shaded area represented by the intersection between People and Systems. The assumption made here is that this can only take place

after an EIS application has been installed in the organisation. In other words, the time dimension that was not shown on the diagram of the framework is assumed to be present. Successful EIS usage could be influenced by people that are not users of the system, various attributes of other systems that the EIS might rely on for input of data. The way the framework is constructed implies that the use of the EIS could also be affected by other factors external to the organisation.

c. Post Implementation Efforts.
The intersection between people activities and systems, reflects development efforts directed towards the expansion and enhancement of the EIS applications already built. This is represented by the intersection of the two shaded areas in the diagram. The people involved in these post-implementation efforts are both users and developers of the system. Again, the framework suggests that people that are neither users nor involved in the development of the system could influence the success of the system in the long term. The systems included in this area are the EIS already developed. Again, the assumption about an implicit time dimension is made here. The various external factors that affect both the development process and use of EISs inherently can affect post-implementation efforts.

d. Automated activities.
The obvious question to ask is why there is no intersection between Systems and Activities and what would such a relationship represent in the context of the framework. The answer to that is simple. The intersection of systems and activities would represent automated activities that would not require the intervention of people to be carried out. These could be triggered by time or any other events. An example of such a relation would be a transaction processing system updating a database at the end of each month. These kind of interaction was not included in the framework for two reasons. First it is not consistent with the concept of expectation failure where people have to be involved, and secondly these interactions are characteristic of other systems and not directly relevant to either EISs development or use.

4 Discussion

A number of frameworks addressing EISs development were reviewed with the intention of identifying their strengths and weaknesses with respect to this research. Based on the insight and understanding gained from this analysis we have proposed an alternative framework to address issues relevant to EISs development and use in a structured manner. Among the different issues the PAS framework addresses are:

a. EIS development and EIS use.
As identified earlier, factors that can influence and determine success or failure of these systems can be classified into two areas: the development process of EISs and the usage of these systems. The framework provides a coherent, structured context to represent and classify elements included in these two areas.

b. Stakeholders.
The idea of systems failure discussed earlier and the notion of expectation failure in relation to information systems, is addressed by the framework. The structure of the framework imposes the identification of a more complete set of stakeholders of the organisation. People that could have an interest in the system are divided could fall into one of four categories in relation to their involvement in the use or development of the system. What is novel about the framework is the recognition of the importance of people who are neither users or developers of the EIS, in the success of the system.

c. Activities.
The EISs development process can be viewed as a project with a set of activities taking place and resulting in the development of an EIS. A project is: '... a collection of human and non-human resources pulled together in a 'temporary' organisation to achieve a specific purpose' [18]. This definition highlights two components: human and non-human factors. These can be viewed as inputs to a set of activities that result to the development of an information system. Besides activities that are specifically directed towards EISs development there might be other activities happening in the organisation that might have an indirect effect on success. The need to include these two sets of activities is addressed by the framework.

d. Other Systems.
The installation of an EIS usually involves the transition from an already existing management reporting infrastructure [3]. The level of technological advancement of an organisation and the culture of the

organisation has an effect on the systems and the path that is followed to reach a full EISs status. The framework considers EISs development in relation to other systems operational in the organisation.

e. External factors.

EISs development is initiated by a set of external pressures as well as internal ones. Many other researchers indicate a set of external factors can influence the development and use of EISs both directly and indirectly. Some of them include the competence of consultants' [7], vendor support and ensuring availability of data held external to the organisation [19]. The framework allows interactions with the external environment to be included in the analysis.

5 Conclusion

The end-user population of EISs, distinguishes them from other information systems. This effectively makes system success depend not only on the way the development process is managed, but also on various factors relating to the use of the system. When developing an EIS, we must have a clear knowledge of the mechanism by which these factors influence success in order to minimise risks of failure. One way to gain such an understanding is by constructing a model of the development process and use of the system and then studies it in more detail. The PAS framework constitutes a useful tool to aid the construction of such a model, by providing a coherent way of classifying elements involved in developing and using an EIS.

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