There Is Life Before Online EIS: A Framework and an Empirical Study

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ABSTRACT

This paper presents a path framework for the development of Executive Information Systems (EIS). As indicated by a sample of 74 organizations, the transition from management information systems (MIS) to Online-EIS is rarely direct. Most organizations first move to a Query stage where online capabilities are acquired, or to a Batch-EIS stage where focus and integration are achieved. The advantages and importance of the Batch-EIS stage are discussed. Using the proposed framework, managers can better understand and plan the transition process for their organizations.

INTRODUCTION

Executive information systems (EIS) are clearly becoming a more significant component of the information systems portfolio in contemporary organizations. Recent research has shown that while EIS cost more than $300,000 (Watson et al., 1995), they are one of the fastest growing sectors of the computer market (Burger, 1995). This paper provides a perspective and empirical observations that can aid in the timing and sequencing of investments in this information technology.

Much of the literature on executive information systems focuses on two areas. The first stream of literature provides descriptive explanations of how EIS work, often with case examples of specific installations (Elam & Leidner, 1995; McNurlin, 1987; Houdeshel & Watson, 1987). The second group of literature provides prescriptive suggestions for the design and implementation of EIS (Barrow, 1990; Watson, 1990). A third approach combines descriptive observations with prescriptive conclusions (DeLong & Rockart, 1992; Volonino & Robinson, 1991; Watson et al., 1995). That is the approach taken in this paper.

A combination of descriptive observations and a framework suggests that management reporting capabilities progress through typical enhancement stages. The transition from the traditional MIS stage to an Online-EIS stage requires a shift along two dimensions: 1) a move from a batch reporting mode to an interactive online environment, and 2) an increase in information integration and focus. A survey of 74 organizations indicates that these shifts are rarely simultaneous. Most organizations first move to a Query stage by acquiring online capabilities, or to a Batch-EIS stage typified by "executive briefing books." Some literature seems to ignore Batch-EIS in favor of the more glamorous Online-EIS. Yet, according to the survey, Batch-EIS are the most common stage before Online-EIS. Furthermore, both periodic and online management

reporting modes have limitations and advantages; In certain situations the Batch-EIS may be a better choice.

PATHS TO EIS: A FRAMEWORK

MIS and EIS are quite similar. Both systems are concerned with monitoring and control, and both have a problem-finding orientation as opposed to the problem-solving orientation of decision support systems (DSS). The main differences between MIS and EIS are in the delivery format, in the extent of data integration across various sources, and in the degree of customization and focus on key executive concerns.

MIS provide managers at various organizational levels with detailed and summarized information about the operation and performance of the organization (Sprague, 1980). However, the delivery format and the content of MIS reports don't satisfy executive needs. The problem boils down to the limitations of pre-defined periodic reports: little focus on the specific concerns of the executive and little integration across organizational functions and boundaries. This is where executive information systems come into play.

EIS are designed to integrate and focus data, enabling executives to monitor and access internal and external information of critical importance to them through effective presentation formats. For example, when monitoring the performance of insurance agents, executive reports may integrate information from various sources to provide key ratios such as claims versus premiums. An online EIS facilitates high-frequency ad-hoc reporting and allows executives to interact directly with the data through a user-friendly interface.

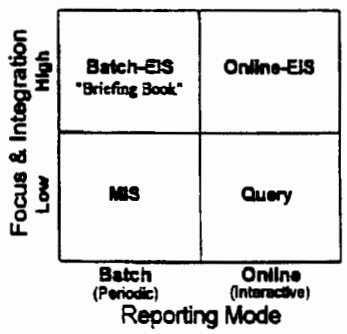

Figure 1. A Framework for EIS Development

Figure 1 presents a two-dimensional framework for EIS development. The focus and integration dimension deals with attention to executive information needs. Systems with high focus and integration combine data from many sources, and selectively provide information of key importance to the executive through effective presentation formats. We decided to collapse focus and integration into one dimension, since we believe they go hand in hand; as attention to executive needs increases, focus and integration would typically increase as well.

The reporting mode dimension is commonly used to characterize information systems by distinguishing between "batch" and "online" systems (Davis & Olson, 1985). Batch systems rely on periodic reporting whereas online systems permit the interactive ad hoc retrieval of information. These two dimensions result in a framework that maps management reporting capabilities into four types of information systems: 1) MIS, 2) Query, 3) Batch-EIS, and 4) Online-EIS.

The typical starting point is an MIS where information is provided through a traditional information system. As described in the previous section, such a system is characterized by sundry batch reports with little integration across functional areas and little focus on critical performance measures. By-product data from transaction processing systems are simply summarized and "pushed" up for periodic review by managers.

As the organization acquires additional management reporting capabilities, the previous reporting methods are typically not abandoned, but rather supplemented. An evolution along the reporting mode dimension from a batch to an online environment, without additional focus and integration, would append reporting capabilities that are typical of Query systems. These systems emphasize access to raw data for analysis by staff personnel rather than performance monitoring by executives.

An evolution along the focus and integration dimension, while remaining limited to the periodic reporting mode, would append reporting capabilities that are typical of Batch-EIS. Such "Executive Briefing Books" are focused on key executive concerns, and they integrate data from various sources. Typically, these paper-based periodic reports provide graphs and tables that present status data and trend lines for key performance indicators and critical success factors. For example, executives may want to monitor the number of new customers, service levels, sales, profitability and financial ratios, capacity utilization, and quality of operations.

The Online-EIS cell represents the most advanced capabilities. The transition from MIS reporting to an Online-EIS requires a shift along two dimensions: 1) an

introduction of online and interactive technologies, and 2) an increase in information integration and focus. Online-EIS capabilities provide for interactive and flexible monitoring of key performance indicators on an ad hoc basis. Typically, these systems also allow the executive to "drill down" and browse through the underlying data.

There are numerous paths that reporting systems may follow as they evolve from MIS to Online-EIS capabilities. The simplest paths are illustrated in Figure 2. Two paths, Via Query and Via Batch, involve transitions along one dimension at a time, while the Direct path evolves simultaneously along both dimensions.

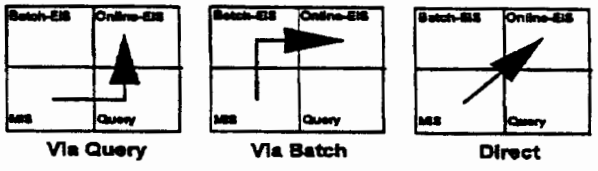

Figure 2: Simple Path Alternatives

It is also possible to move from Query to Batch-EIS or vice-versa, as illustrated in Figure 3. In such cases the functionality of the second dimension is being added, but without sufficient links between the online capabilities and the EIS information to qualify as Online-EIS. For example, an online sales and marketing information system may serve the needs of staff professionals, while an executive briefing book serves top-management.

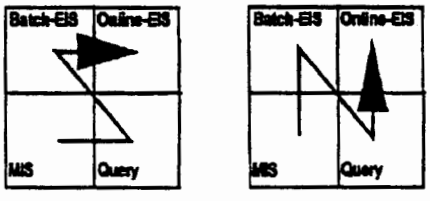

Figure 3: Zigzag Path Alternatives

THE STUDY

In order to enrich the proposed framework with empirical data, a study was conducted using a convenience sample of two groups of subjects. The first group consisted of part-time graduate business students in several sections of MIS and DSS courses spanning a period of two years. The second group consisted of attendees of a session on EIS at the 1991 International Conference on Decision Support Systems.

Only about a half of the students and a third of the conference session attendees were familiar enough with the history of information systems in their organizations. This resulted in 66 valid responses from the first group and eight valid responses from the second group. The reason for using two different groups of subjects was simply to increase the sample size. Since both groups were based on a convenience sample, the effect of combining two non-random groups leaves us with the same level of caution in attempting to generalize the results.

The organizations represented in the study belong to various industry segments: service, hi-tech, finance, manufacturing, health care, government, and retail. These were generally mature organizations, averaging 20,000 employees and 58 years of operation.

After explaining the framework in Figure 1, the subjects used a questionnaire with that figure to indicate the evolution path taken by their organization. This was done by simply drawing the sequence of acquired reporting capabilities. Table 1 shows the frequency distribution for the paths of evolution taken by the respondents' organizations. The Path column indicates the sequence through the quadrants in Figure 1. For example, the most frequent path indicates that sixteen organizations moved from MIS to Query and then to Batch-EIS.

Table 1: Frequency Distribution of Paths

Evolution Path	N
MIS - Query - Batch EIS	16
MIS - Query	15
MIS - Batch EIS - Online EIS	9
MIS - Batch EIS - Query - Online EIS	8
MIS - Batch EIS	6
MIS - Query - Batch EIS - Online EIS	6
MIS - Query - Online EIS	5
MIS - Batch EIS - Query	4
MIS - Batch EIS - Online EIS - Query	2
MIS	1
MIS - Query - Online EIS - Batch EIS	1
MIS - Query - Online EIS - Batch EIS - Online EIS	1

Table 1 provides several insights. First, all 74 organizations did indeed begin with MIS capabilities as the starting point. Second, more than forty percent of these organizations had achieved Online-EIS capabilities at the time of the survey. Third, and perhaps most surprising, none of these organizations went directly from MIS to Online-EIS.

Figure 4 presents a different view of the data. It depicts how many companies transitioned between each pair of cells in the framework. Wider arrows represent more popular transitions. There is considerable bi-directional activity between most pairs of cells, but there are no direct transitions between MIS and Online-EIS. Furthermore, although most organizations transition out of MIS by first adding Query capabilities, half of these organizations went on to Batch-EIS. Indeed, the leading transition into Online-EIS capabilities was through a Batch-EIS stage rather than from a Query system.

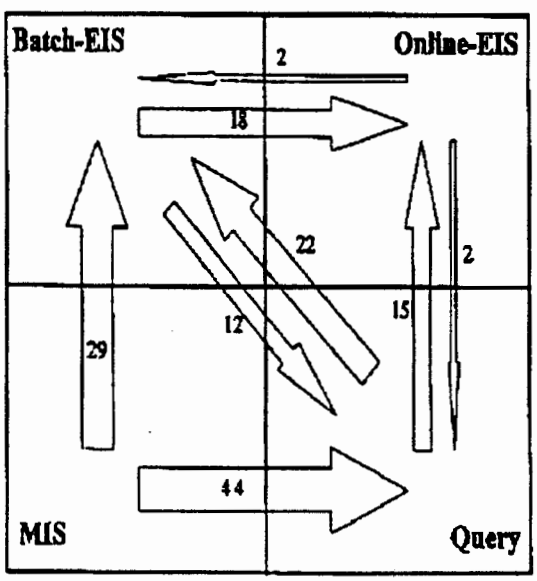

Figure 4: Transitions Between Cells

DISCUSSION

Out of 74 organizations in the study, 32 have reached an Online-EIS stage. This high proportion reflects the non-random nature of the sample, but allows a richer analysis of the paths taken by these organizations. The following discussion attempts to explain the prominence of Batch-EIS by examining the limitations and advantages of Batch-EIS versus Online-EIS.

Paths to Online-EIS

The single most popular road to Online-EIS was the Via Batch-EIS path (see Figure 2). Out of 32 organizations that reached Online-EIS, eleven (34%) did so by moving from MIS through Batch-EIS. Two of these eleven organizations went on to add Query capabilities after reaching the Online-EIS stage.

The Batch-EIS stage featured prominently in other paths as well. Nearly half (44%) of the organizations reached Online-EIS by following the two Zigzag paths (See Figure 3). Eight organizations went through Batch-EIS and then Query before reaching Online-EIS, while six went through Query and then Batch-EIS. These results suggest that both Batch-EIS and Query systems provide beneficial and complementing experiences as a foundation to Online-EIS.

Seven (22%) of the 32 organizations reached Online-EIS through the Via Query path. Surprisingly, two of these organizations went on to add Batch-EIS capabilities after reaching the Online-EIS stage. In one of these cases, the Online-EIS simply failed after a while, and the company turned to a Batch-EIS before attempting a second Online-EIS.

The Direct Path from an MIS to an Online-EIS might be a tempting strategy. It may seem that this path could be accomplished much faster than any other, and perhaps with the expenditure of less resources. In addition, certain political forces may push for a premature transition from MIS to Online-EIS. An executive may request such an investment after viewing an Online-EIS at another organization or after a demonstration by an EIS vendor. Alternatively, the MIS department may see such a project as an exciting technological adventure that can provide higher development budgets and increased visibility. However, none of the organizations in the sample chose this route, which suggests that the Direct Path is not very practical. In general, making incremental changes is usually a preferred organizational approach (Quinn, 1978). Attempting to make two transitions simultaneously compounds the difficulty of implementing a new system and would thus increase the risk of failure.

The Prominence of the Batch-EIS Stage

The Batch-EIS stage featured in 25 (78%) of the paths to Online-EIS. In addition, as mentioned above, two organizations went on to add Batch-EIS capabilities after reaching Online-EIS. Overall, 84% of the organizations who reached Online-EIS also used Batch-EIS.

It seems that Batch-EIS may deserve more attention. An obvious question is "why are Batch-EIS so prominent as a stage before Online-EIS?" One possible explanation is that Online-EIS are a more recent phenomenon due to advances in hardware, software, telecommunications, and data management technologies. According to this view, Online-EIS technology is rendering the Batch-EIS stage obsolete.

Yet, we believe that the Batch-EIS stage may also offer some unique benefits, and will remain viable for quite some time. The Batch-EIS stage provides an incubation period where the information sources, the critical success factors, and the key performance indicators are developed and refined in an evolutionary manner. Such a process allows organizations to keep costs and risk down, maintain flexibility, and ease the organization into a period of enhanced executive monitoring. The path through the Batch-EIS stage also allows executives to become familiar with available data, presentation formats, and their own information needs.

Online-EIS have thus far been presented as an ideal. However, the popularity of Batch-EIS suggests that the periodic "executive briefing book" approach may have some overlooked advantages. At the same time, Online-EIS might suffer from some interesting limitations such as lower flexibility, difficulty in sharing information, and detrimental effects on decision quality and time orientation.

Possible Limitations of Online-EIS

Online-EIS may be less flexible due to the elaborate structure and design behind them. For example, if the EIS provides four graphs on one screen, depicting four major sales territories, a conversion to five territories might require substantial modifications. In addition, the electronic medium may limit the ability of managers to annotate, share, and use the information away from their desk.

Online-EIS typically provide access to deep levels of backup detail. Yet, supplying executives with detailed data without analysis and without recommendations might lead to premature decisions and to deterioration of top-level decision making quality. This may be aggravated by the leaner, flatter organizational structures pursued by today's organizations. Furthermore, too much executive involvement with "micro-management" might prove disruptive to staff and line work.

Online-EIS might also bias the organization's agenda and time orientation. Executives will spend more of their time, and the time of subordinates, on information and issues presented by the EIS. It may also result in an increased orientation toward the short term in reaction to the tighter and more frequent feedback supplied by the EIS. This seems undesirable in view of common claims that American executives are already biased toward the short term (Kerr, 1975; Webber, 1980; Gordon, 1983; Iaccoca, 1984; Silver, 1988).

A more subtle source of agenda and time horizon bias might be found in defensive chain reactions throughout the organization. Lower-level managers take notice very quickly when executives begin to monitor certain dimensions of their performance. These managers often shift their agenda and shorten their time horizon at the expense of overall organizational performance.

Consider, for example, a case mentioned by Rockart and DeLong (1988) where a system was developed for the chairman of a firm to track the response time of departments to his correspondence. The system is credited with reducing the average response time from fifteen to less than five days. This "achievement" might have had the hidden, but dire, consequences of generating disruptive work patterns throughout the organization as respondents drop high-priority tasks in favor of answering memos.

There is another potential danger that may be associated with Online-EIS. Previous literature (Forrester, 1968; Roberts, 1978; Rasmussen, 1988) suggests that managerial systems might demonstrate oscillations or even chaotic behavior under certain conditions of external disturbance and internal feedback and adjustment. Similar concerns were recently expressed in relation to database technology:

> Information feedback that is too rapid and not controlled properly is very destabilizing for a system, causing its behavior to oscillate wildly ... we may inadvertently destabilize large organizations by forcing them to react too quickly to changes (Chapnic, 1989).

Online-EIS might throw organizations into oscillations or even chaotic behavior in cases where executives overreact to the supplied information by making adjustments that are too frequent and too strong.

Possible Advantages of Batch-EIS

72% of the 74 surveyed organizations reached or passed through the Batch-EIS stage. Clearly the Batch-EIS stage is important. Yet, it receives relatively little attention in MIS and EIS literature. This section attempts to outline potential advantages of periodic executive reporting.

Periodic reporting facilitates discussion by providing consistent information on a regular basis for simultaneous review by all managers. These reporting cycles synchronize organizational actions and decisions by driving coordinative management processes such as monthly review meetings. A periodic review of all performance indicators permits managers to make decisions and prioritize issues with a more global perspective. This has the added benefit of clearly communicating priorities to subordinates and reducing confusion. The sense of shared perspective can also promote cohesiveness, commitment to the organizational agenda, and management teamwork.

With Online-EIS, the executive might neglect to review some performance dimensions, and might be tempted to react to information on a "last come first served" basis. The periodic mode can thus minimize disruptions due to scattered executive inquiries that might be typical of the Online-EIS mode.

A periodic distribution of hard copy reports on key performance indicators to various levels of management has certain advantages. The hard copy format of Batch-EIS reporting facilitates hand written annotation, distribution, and communication with peers and subordinates. The distribution of the report to various levels of management increases motivation due to increased performance feedback.

Even after a transition to an Online-EIS, most organizations maintain some periodic reporting. In a previous study, EIS experts estimated that the majority of EIS usage was by way of standard reports, and that most of these standard reports were used periodically (Millet & Mawhinney, 1992). In many cases the periodic reporting is driven by the periodic nature of updates to the information database feeding the EIS. Still, further research may indicate that the use of periodic reports is at least partially motivated by the organizational considerations mentioned above.

When we asked a CEO of a computer equipment and technical services company about his choice between an Online-EIS and a paper-based executive briefing book, the CEO raised many of the issues discussed above:

> I would prefer seeing the reports on paper. I can scribble on the reports and mark them. I can also ask many questions sitting with the other managers while reviewing the reports ... Today I get monthly reports summarizing all the important management information in five pages. I can quickly scan things like cash, profit, sales, and backlog; then I can use various colors to mark unsettling questions to members of my management team. I think that for our modus operandi, a briefing book approach is more convenient ... Still, if I had a need to get much more data and to slice and dice it in various ways, drilling down to micro data rather than remaining at the macro level, then I expect I would have preferred using an online system...
>
> ...Reviewing the periodic reports with the six members of my management team, also helps me in understanding the report and in making decisions about corrective action. The managers explain why spare-part consumption went up, why temporary manpower was used, etc... This is a dialog that forms while the reports are being reviewed -- without it, a set of numbers on a computer screen is worth nothing (Rabinovitz, 1992).

Similar comments were made by managers in a study of 12 manufacturing companies:

> I find it tough to sit in front of a terminal reading numbers or mail. I like to have it on a piece of paper that I can stick in my briefcase, take home with me, and jot notes in the margin. I don't find it useful to be tied to a machine (A manager quoted in McKinnon and Bruns, 1992, p. 158).

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this paper was to clarify and investigate the alternative paths available for EIS development. According to the proposed framework, organizations make transitions from MIS to EIS by: 1) acquiring online capabilities, and 2) increasing focus and integration in information provided to managers. This results in four distinct stages. The study demonstrates that organizations follow several paths through these stages before reaching Online-EIS capabilities.

Implications for Information Technology Management

Using this framework, managers of information technology can better understand and plan the transition process for their organization. They should identify where they are in the framework, the stage they want to reach, and

the path they want to follow in order to get there. In particular, it seems that serious consideration should be given to acquiring or improving Batch-EIS capabilities before pursuing the Online-EIS stage.

Movement along either dimension in the proposed framework requires significant technological and organizational change. Attempting to effect both transitions simultaneously might be seductive, but is probably ill-advised. Indeed, none of the organizations in the study attempted such a direct path.

According to the framework, a demand for EIS capabilities can signal a need to improve format and content of management reports, a need to improve the delivery mechanisms for these reports, or both. It is important to identify and address the actual need. For example, if the main problem in the current system is the lack of focus and integration, the first step should be to analyze current management reports for opportunities to improve their format and content (Millet, 1995).

Several limitations of Online-EIS have been described in this paper, suggesting that it is not necessarily the best type of EIS for all organizations. However, some of these limitations will diminish as technology improves and becomes more widely available. Advances in computer supported collaborative work (CSCW) and in document management technologies are particularly relevant for Online-EIS (Greif, 1991). Such capabilities include: 1) simultaneous voice/data communication so that physically dispersed persons can simultaneously view and discuss a problem, 2) the ability to send, view, edit, and print fully formatted documents across different types of hardware platforms, and 3) the ability to make handwritten or voice annotations on an electronic document and forward copies to colleagues. Managers of information systems should consider applying these technologies not only for EIS deployment but also for lower-level reporting applications.

Future Research

Much research still needs to be done on the framework and its implications. In particular, the rationale for following one path rather than another, and the levels of satisfaction related to each path should be investigated. For example, one interesting research hypothesis is that Online-EIS enjoy a higher rate of success if they are preceded by a Batch-EIS stage.

Further research on the effects of periodic versus non-periodic reporting could yield interesting insights and contingency frameworks that could be useful for EIS implementations as well as for the MIS domain in general. EIS research should also investigate the possible organizational liabilities and biases that might be introduced by Online-EIS. The existence and extent of those phenomena should be ascertained and possible mitigating approaches should be devised.

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