

# Decision Support for Executives: Executive Information Systems

---

***Dr Dennis Viehiand, Centre for Computing and information Technology,  
University of Arizona, United States of America<sup>1</sup>***

## Abstract

*An executive information system (EIS) is a decision support system for the executive. What distinguishes an EIS from other information systems is that the end user is the executive. The executive as end user imposes new and special requirements on the system. Some of these requirements are technological, but it is the data requirements and design of the system to meet strategic planning needs that are of most interest to institutional researchers. This paper offers a definition of EIS, compares EIS with its predecessors, outlines the technological and data requirements for executive information systems in higher education, and proposes an agenda of action items institutional researchers can take to prepare for the emergence of executive information systems.*

## Definition of Executive Information Systems

Executive information systems (EIS) represent an evolutionary advancement in information systems for decision support. Previous generations of information systems either were unconcerned with executive support or required the executive's staff to play an intermediary role between the executive and the data. What distinguishes an EIS from its predecessors is that *the end user is the executive* - it is a decision support system for the executive.

For the purposes of this paper, a formal definition of an executive information system is as follows: *an interactive computer-based system that allows executive officers to access data and information to identify problems, explore solutions, and guide the strategic planning process.* The purpose of an executive information system is to deliver data to the desktop of the executive officers and transform it into information that conveys useful knowledge to the executive. This information is used to investigate solutions for pressing managerial problems and make planning decisions for the institution.

## Information Technology for EIS

The executive as end user imposes several new requirements on the technology. These requirements help define the characteristics of an executive information system.

An EIS must be "executive-friendly", matching the computer skills of this type of user. For example, an EIS that depends entirely on use of the keyboard will not be used by most executives. A menu mode with windows, pull-down menus, and a mouse or touch-sensitive screen should be available. A command mode also should be included for computer-savvy users. An EIS also must be very forgiving. It should allow an executive to undo a procedure or backtrack to previous screens. On-line, context-sensitive help is also required.

The system must meet the needs of the executive in terms of speed. Time is a critical resource for the executive and any system that takes longer than a few seconds to change screens, compile data, or present a graphic will not be acceptable. If a complex operation is required, such as obtaining data from a mainframe base, an EIS should give executives the option of performing the task in background while they move on to other tasks.

---

<sup>1</sup> **Acknowledgment:** An earlier version of this paper was presented at the 30th Annual Forum of the Association for Institutional Research, Louisville, Kentucky, May 1990.

Executive information systems must be graphic-oriented and able to deliver a variety of graphical displays. An EIS user will not only want to see the numbers, but also how the numbers look in a bar graph, pie chart, or line plot. This enhances the executives' ability to spot trends and discrepancies and communicate their findings to colleagues, subordinates or external audiences. The benefits of graphic displays over numerical tables are well-known (Tuft, 1983); an EIS exploits these advantages to give executives a better understanding of the data and a readily-available presentation tool.

The principal platform for an executive information system should be the administrative desktop computer. The information processing functions of the EIS are best suited for the computer-intensive capabilities of the executive's workstation and mainframe computer usage should be restricted to transaction processing and data storage, the areas where mainframe processing capability and storage capacity are required. This system of cooperative processing conserves mainframe resources and assigns the personalised tasks of data manipulation, analysis, graphics, and telecommunications to the desktop computer.

Those familiar with today's office automation environment know these requirements severely strain the limits of current information technology. As a result, the EIS failure rate is high and relatively few executives use an EIS. However, as information technology advances beyond the personal computer to the workstation environment, executive information systems will become more feasible and more numerous.

## Data Requirements for EIS

The information system requirements of an EIS also are considerable. In addition to providing the executive with basic institutional data, the information system should include the following capabilities:

- Integration of data from different data bases, student, financial and personnel, is necessary to allow executives to view and analyse related data from separate data bases, such as student' faculty ratios and research expenditures per faculty.
- Occasionally, an executive will need data from on-line data bases, such as current status of budget accounts. More frequently, the executive will require access to official record data that is maintained in a static, summary data base. For example, student enrolment as of the last official census date is likely to be more useful to an executive than enrolment as of the current day. Access to an information support data base of official record data ensures consistency in reporting and allows reconciliation with official institutional records.
- Inevitably, the executive will want to drill down or view detailed data that comprise summarised data. For example, a president may want to see expenditure data by department after viewing college-level data. Drilling down allows the executive to discover exceptions or anomalies.
- Executives are usually more interested in seeing trends rather than one year in isolation. Historical data allows year-by-year comparisons and helps the executive place current year data in context. This requirement reinforces the need for an information support data base of official record data. Generally, only this data is comparable across time, a fundamental requirement for trend analysis.
- Information is always more meaningful if viewed in comparison to a peer group of institutions. This means the EIS should be able to access external data that is comparable to institutional data in the original data set.
- Information for executive support must be delivered in a form that is determined by the critical success factors of the executive. These have been defined as "those few key variables about which reliable data is absolutely necessary to make wise strategic choices and to assess progress toward goals" (Cope, 1986, p70). In the higher education environment some critical success factors, such as enrolment indicators and qualitative measures, are universal, but other factors, like peer group comparisons and economic development data, will depend on the institution's strategic mission and the needs of the individual executive for financial ratios and service measures. The search for useful

information is inherently a personalised task because information needs will depend on the executive and the particular decision to be addressed. Identifying and meeting the critical success factors of the executive is essential for successful implementation.

These data requirements make an executive information system a natural progression of what an information system for decision support was always supposed to be - a decision support system for the decision-maker.

## EIS in an Executive Support System

There is yet another attribute of executive information systems, one that draws the biggest distinction of all from previous generations of information systems. An EIS does not stand alone. It functions as the central, core portion of an executive support system (ESS). There is considerable confusion about EIS versus ESS; many magazine articles use these terms interchangeably and most authors fail to define them clearly. In this paper an executive support system is defined as three separate, but overlapping, components. These three parts roughly follow Rockart and Delong's (1988) description of the "managerial purposes" of an ESS:

**Mental modelling.** This process begins with designing the EIS. The executive user is asked to identify critical success factors, data, ratios and other information the executive needs to monitor the performance of the college or university. As the EIS is prototyped, the executive builds mental models of the institution and these models are identified and integrated into the EIS. Eventually, a circular process is established and the executive's perspective of the institutional environment is enhanced by the EIS. When the mental model is altered, the EIS is readjusted and the process starts over again.

The use of an EIS for mental modelling can be especially useful for managers new to an institution. Reviewing the library of tables and graphics used by the executive's predecessor informs the new person about planning activities of their predecessor and helps the new executive to build a mental model of the institution.

**Executive information system.** The executive information system is the people, technology, and policies that deliver data to the executive and transform it into information.

**Office automation support.** Before making a decision the executive will need to consult with staff, solicit opinions from individuals affected by the decision and analyse options. After making a decision the executive needs to be able to communicate that decision and follow-up on it later. These are tasks in which the data from an EIS will be secondary to the need for electronic mail, tickler files, schedulers and mail logs. These are examples of applications used in this third, critical component of ESS. The computer savvy manager may need additional tools, such as personal information managers, outliners and access to statistical packages.

In summary, in this paper an executive support system is defined to include mental modelling, an EIS, and office automation support. Others, like Gulden and Ewers (1989), have defined the components differently, but almost always the executive information system is seen as a component of the more comprehensive executive support system.

## Information Systems for Decision Support

Executive support systems represent evolutionary, rather than revolutionary, advancement up the information systems evolutionary ladder. In this context ESS includes executive information systems, as well as mental modelling and office automation support. To provide an historical context for ESS, Table 1 compares ESS with EDP (electronic data processing), MIS (management information systems) and DSS (decision support systems).

Table 1: Comparison of EDP, MIS, DSS, and ESS

	<b>Electronic Data Processing</b>	<b>Management Information Systems</b>	<b>Decision Support Systems</b>	<b>Executive Support Systems</b>
<b>Focus</b>	Data	Information	Information for decision support	Comprehensive decision support
<b>Goal</b>	Efficient transaction processing	Structured information flows	Decision support	Decision support on the executive's desktop
<b>Output</b>	Database	Report generation	Models, data links, summary data base	Information and graphics to assess critical success factors
<b>User Interface</b>	Summary report	Enquiry and report	Interactive, data-oriented	Interactive, graphic-oriented
<b>Hardware</b>	Mainframe computers	Mainframe computers	Mainframes and microcomputers	Principally executive workstations
<b>Software</b>	Batch processing	Database	Spreadsheets, statistical packages, graphics	Graphics, e-mail, personal information managers

The current high level of interest in executive information systems comes from the recognition the best decision support system is one that meets the needs of senior managers. In many respects EIS is the logical conclusion of information system development because an EIS is information processing for executive decision support.

## Executive Information Systems in Business

As was the case with previous generations of administrative information systems, the implementation and use of executive information systems began in the private business sector; only recently have institutions of higher education begun to incorporate executive information system technology from the business sector into the university administrative environment. This section gives a brief overview of EIS in the American private business sector, with special emphasis on software used by service and industrial firms.

Although no comprehensive survey of EIS/ESS use in business is available, it appears that the principal use of EIS in this sector is for operational and/or control decisions. Interestingly, much of the management literature in this area focuses on the fragmented character of executive work, especially the unstructured nature of decisions that occur at this level. However, product demonstrations, software literature, and anecdotes of EIS applications (e.g., Rockart and Delong, 1988) place far more emphasis on the use of information for management control decisions, rather than strategic planning or similar applications. It is far more likely an EIS will be used to access sales data, a balance sheet, or stock market prices, than environmental scanning data, predictive models or similar information for strategic planning.

Because the primary use of EIS/ESS in business is for management control, the basic data for EIS are financial data. Again, software demonstrations, product literature, and anecdotes in the EIS literature emphasise most executive information systems are used primarily for access to and analysis of financial data (Chapter 5 of Rockart and Delong). Although EIS development has occurred in a variety of industries, financial institutions, such as banks and insurance companies, have been major targets for EIS development.

## Executive Information Systems in Higher Education

Few observers of computing in higher education anticipated the advancement of desktop computing from almost non-existence in the late 1970's to the ubiquitous use of personal computers in classrooms, laboratories, and administrative offices today. This increase in microcomputer use can be attributed to more powerful desktop computers, multiplication of new applications, and integration of various systems, micros, minis and mainframes (Green, 1988). More subtly, generous discounts and donations by hardware and software vendors to institutions of higher learning have encouraged the placement of computers on virtually every administrative desktop.

There is no reason to believe this growth will not continue for the same reasons that have fuelled this expansion. Especially, as desktop computers become more powerful and the interconnectivity of systems between micro and mainframe increases, the number of administrative personnel who use computers in their jobs will continue to grow.

## Developing Information Systems for Executive Support

Implementation of a comprehensive EIS similar to the one described earlier in this paper is an option at relatively few institutions. An executive information system that meets the technological and data requirements described in the first section requires leading edge technology, integrated software environment, institutional data base sufficient to provide a high level of decision support, and an executive environment with a considerable degree of computer literacy. These are substantial requirements and few higher education institutions are ready to meet these challenges.

So what is to be done? Institutional researchers, acting in cooperation with information systems professionals, can do several things to prepare for an executive information system:

- Build a complete and efficient data warehouse. If your institution's data management system can sustain a decision support system, information centre or similar function, then you have taken the first big step toward an EIS. In reviewing Table 1, if you find your institution is still at the MIS generation, as many are, build a decision support system first. In other words, do not try to skip a generation of information systems because if the data foundation is not there, the EIS structure will be difficult to build and maintain.
- Prototype an executive information system. Executive information systems are rarely, if ever, introduced into the executive suite as comprehensive information systems (if they are it is always at considerable expense). Instead, most executive information systems begin with a modest effort that is frequently initiated by an institutional research office.

Perhaps the most common prototype path is to use current information technology and build on what is in place. At the University of Hartford, for example, the Institutional Research and Planning Office has implemented a Lotus-based EIS that is used for DSS oriented activities of a predictive nature, like enrolment planning and financial models.

A second prototype path for an EIS is an electronic fact book. Most institutions have paper fact books that contain data the executive finds useful. Various approaches to electronic fact books have been implemented at the University of California-Irvine (Daly, 1985), University of Tennessee (Geros, 1988), and the University of Colorado (Sokol, 1989). Electronic fact book development can be a back door to identifying critical success factors. Ask an executive what they want from an EIS and they are likely to ask what you have. An alternative approach is to put the institutional fact book on-line and monitor what screens executives find to be useful. The electronic fact book becomes the foundation for an EIS as it is extended with increased capabilities, such as graphics and data links to the transaction processing system or an information support data base.

A final prototype path is a hypertext application for executive office automation support. Hypertext is somewhat difficult to define, but basically it is organising information so anyone can quickly find what they need to know without previous knowledge of the software, computer or subject. Hypertext also implies a linking of information together

- the way a human mind works - so connections between ideas, explanations and data can be linked together. For example, by pointing to a keyword in a sentence and selecting it, the linkage is activated and associated information revealed. One example of a hypertext EIS is a college-level EIS at the University of Arizona. The dean and department chairs use a RAM-resident hypertext program that at the touch of a key provides them with access to an administrative calendar, staff directory, mission statement, budget analysis, and various college planning documents. A more fully-developed hypertext EIS is in place at Baylor University. Here, the University's computer centre has developed a

Macintosh-based “Baylor University Chairman’s Workstation” (BUCW). The BUCW uses Hypercard, an Apple hypertext product, and Mac WorkStation to query five databases, faculty/staff directory, student directory, library system, student information system and recruitment directories. The BUCW is for query purposes only, the system having no graphics and minimal analysis and report writing capabilities.

- Establish a political agenda for development of executive information systems. Most critically, build support for EIS initiatives at many levels. Currently, many higher education executives are not computer literate and have little or no desire to change. Their long tenure in administrative positions, well-developed support staffs, and lack of computer experience make these executives difficult targets for EIS implementation. Other managers, such as deans, are more familiar with computing and, as they move up into the executive suite, they will bring their computers with them. With the approval of senior management, target these managers for information system development. Similarly, target new executives for EIS development. New executives tend to be hungry for data access; executives who have been in the organisation for a long time are likely to be less interested. Finally, target multiple offices for EIS development. Do not define “executive” as just the presidential and vice-presidential levels; plan for EIS to spread into other offices, such as deans, department chairs, and support staff. These institutional officers have similar information needs as the president and vice-presidents and the EIS will have the greatest value when applied at this level, rather than just at the pinnacle of the organisation. Successful executive information systems should be built as organisational solutions, not to serve a single individual or small group of executives.
- Put office automation support in the executive’s offices. Much of the software necessary for the third element of ESS is currently available. Office automation support is frequently viewed as the easiest component of EIS to implement with current technology.

While most colleges and universities have not begun development of an executive information system, some institutions have already initiated the process. This list of action items for developing executive information systems is not a comprehensive list, but are illustrative examples of EIS development opportunities.

## EIS Applications in Higher Education

What is the future of executive information systems in higher education? How important will EIS be to institutional executives, and what purposes will EIS serve? Certainly, the development of EIS in higher education will be different than that for the business sector. Higher education institutions are not profit-oriented enterprises and the financial management and control decisions typical of EIS implementation in the business sector will not be found in higher education. It seems likely that colleges and universities will place more emphasis on the use of executive information systems for strategic planning applications, such as enrolment management, program development, and resource allocation, rather than financial control decisions.

In view of the potential offered to higher education institutions by executive information systems, can one expect the use of EIS to become widespread in higher education? If experience with other information systems is any guide, the answer to this question is “probably not.” It is likely EIS development will occur slowly and will differ markedly from institution to institution. American colleges and universities usually have been on the ‘lagging edge’ of information system development. Although the theoretical frameworks and organisational strategies for new information systems have been developed in university business schools, introduction and development of these systems has occurred in the private business sector. The development of EIS will probably parallel the sporadic development that has characterised DSS development. That is, the managerial environment, computer systems, and institutional culture have encouraged DSS development in some institutions, while others, probably a majority, have failed to implement any type of comprehensive DSS. So it likely will be with executive information systems in institutions where the conditions are favourable and there is a strong background of using data for decision support, EIS development will flourish. In other institutions, EIS development will not occur. In

the end no single conclusion can be made about the future of EIS in higher education, it will be a different path for each institution.

## References

Robert G Cope, "Information System Requirements for Strategic Choices" in *New Directions for Institutional Research: Environmental Scanning for Strategic Leadership*, Patrick M Callen (ed), Jossey-Bass, San Francisco, 1986, pp 69-75.

Robert F Daly, "The Electronic Factbook", a presentation at the Association for Institutional Research Forum, Portland, Oregon, 30 April 1985.

Kenneth C Green, "The New Administrative Computing" in *New Directions for Higher Education: Making Computers Work for Administrators*, Kenneth C Green and Steven W Gilbert (eds), Jossey-Bass, San Francisco, 1988, pp 5-11.

Jolene S Geros, "An Electronic Factbook: Design, Implementation and Evaluation", a presentation at the Association for Institutional Research Forum, Baltimore, Maryland, May 2, 1989.

Gary K Gulden and Douglas E Ewers, "Is Your ESS Meeting the Need", in *Computerworld*, 10 July 1989, pp 85-88, 90-91.

John F Rockart and David W DeLong, *Executive Support Systems*, Dow Jones-Irwin, Homewood, Illinois, 1988.

Denise Sokol and Terry Bittner, "An Electronic Fact Book", a presentation at Rocky Mountain Association for Institutional Research Conference, Las Vegas, Nevada, 19 October 1989.

Edward R Tufte, *The Visual Display of Quantitative Information*, Graphics Press, Cheshire, Connecticut, 1983.

## Appendix: EIS Lists

*Author's note: Some of the advice offered in these lists duplicates points made in the paper.*

### What EIS Professionals Worry About

At EIS88 delegates were asked to rank their greatest concerns about implementing a system in their organisation. This is a summary of their responses in rank order of importance:

1. Getting executives to specify what they want.
2. Making sure EIS data is accurate.
3. Combining data from multiple sources.
4. Having sufficient staff and computer resources to support the EIS.
5. Finding a problem big enough for the EIS system to have real impact.
6. Making sure executives have enough time to use the system.
7. Keeping abreast of executives' changing needs and desires.
8. Avoiding political foot-dragging and back-stabbing.
9. Dealing with executives' dislike of technology.
10. Deciding what hardware and software to use

### ESS Tips from the Experts

1. Ensure you have executive support.
2. Focus on the business first, not technology.
3. Prototype the system.
4. Make the system visually attractive.
5. Take advantage of anything to keep executive hands off the keyboard.
6. Do not reinvent the wheel.
7. Turn data providers into partners.
8. Provide executive-level training for executives.
9. Provide for expansion.
10. Expect the ESS to be an ongoing process.

From *Blueprint for Developing an Executive Support System* by Cynthia Sherian, Execucom Systems Corporation.

### Eight Factors Critical to Successful ESS Implementation

1. A committed and informed executive sponsor.
2. An operating sponsor.
3. Appropriate information system staff.
4. Appropriate technology.
5. Management of data.
6. Clear link to business objectives.
7. Management of organisational resistance.
8. Management of system evolution and spread

From *Executive Support Systems: The Emergence of Top Management Computer Use* by John F Rockart and David W Delong.