3-03-25 Guidelines for Designing EIS Interfaces

Hugh J. Watson
John Satzinger

Payoff

For users of an executive information system (EIS), the EIS interface is the system. Here are eight guidelines for designing an EIS interface, all of which are derived from experience with actual EISs that are successfully meeting the unique information needs of business executives.

Introduction

Executive information systems are among the fastest-growing applications in corporate America. They are designed to supply senior executives with needed information, such as news and stock prices and information about competitors, customers, Key Performance Indicator, and internal operations. Most large firms have an Executive Information System in place or are planning to develop one, and even smaller firms are implementing them.

A major factor leading to the development of executive information systems is executives' need for better information in today's competitive business environment. Another is the availability of special-purpose EIS software that facilitates the development of an EIS. Pilot Software, Inc. (Boston MA) and Comshare, Inc. (Ann Arbor MI) led the way with their products in the mid-1980's; today, a host of other products are available. As successes with Executive Information System at such corporations as Northwest Industries, Ltd., Lockheed Aeronautical Systems Co., Xerox Corp., Quaker Oats Co., and Beneficial Corp. have become widely known, executives and IS managers have recognized the potential of EIS and championed their development.

As part of the research program on executive information systems at the University of Georgia, EIS practices at leading-edge firms have been studied. The program consults with many EIS developers using most available EIS products. The information from this research has yielded specific guidelines for developing EIS user interfaces.

The guidelines presented in this article can be usefully applied by EIS developers. They are also helpful to executives, so they will know what to ask for and expect in their EIS. The guidelines are illustrated with specific examples, many of which are from Lockheed Aeronautical Systems, which developed one of the first successful EIS.

Definition of an EIS User Interface

In building a successful Executive Information System, a myriad of technical, organizational, and managerial issues must be addressed. Of utmost importance is creating an EIS that is easy to use. Executives have little time or patience with difficult systems.

The term user interface refers to how the user directs the operation of the system (e.g., keyboard, mouse, or touchscreen; question/answer, command language, or menus) and how the output is given to the user (e.g., graphical, tabular, or textual; color or monochrome; paper or online). For the system to be easy to use, the user must know how to make it work and what the output means. A user interface must be designed to make operating the system and interpreting the output as easy as possible.
Designing an EIS user interface is different from designing other information systems. Because of the nature of executive users, the system must be more than user-friendly; it must also be user-intuitive, even user-seductive.

Another difference is the flexibility the system must have, because it is difficult to determine how a particular executive will use an EIS. Also, because of advances in hardware and software, systems designers have many new options to choose from when implementing an EIS.

A successful EIS often benefits other users in addition to executives. For this reason, it has been argued that EIS also stands for “everybody’s information system.” These users are more likely to accept complex user interfaces than senior executives and may be willing to trade off simplicity for flexibility. In many instances, however, the more complex applications created for lower-organizational-level users are not given to executives. For example, an executive may not need an application that provides advanced query capabilities to analyze sales data. The focus of attention in this article is on the design of user interfaces for executives rather than for lower-level organizational personnel.

**Design Guidelines**

Developers of an Executive Information System are typically building their first system of this type. The EIS users, information content, and software are often different from previous systems development projects. Poor initial choices can undermine or even eliminate the chances for successful implementation. Some EIS have not been as successful as they might be or have even failed because of poor user interface designs.

The following eight guidelines on designing an EIS interface should help developers successfully implement an EIS:

- Involving executives in the design of the user interface.
- Setting standards for screen layout, format, and color.
- Using the system should be intuitive.
- Using standard definitions of terms.
- Designing the main menu as a gateway to all computer use.
- Designing the system for ease of navigation.
- Striving to make response time as fast as possible.
- Expecting preferences in user interfaces to change.

In the following sections these guidelines are examined and illustrated with examples from successful EIS implementations.

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Involving Executives in User Interface Design

Although user involvement in the systems development process is critical for all types of information systems, executive involvement in the design of an Executive Information System user interface is especially important. Executives might have limited experience working directly with a computer, and if they do have some computer experience, the EIS will look and feel quite different from any organizational information systems the executives might know.

Designers should be prepared to show a variety of prototype screens and navigation approaches because the executive might have limited knowledge of what an EIS can actually do. Evaluating these prototypes is also likely to get apprehensive executives more committed to the EIS as they begin to see the system's potential. For this reason, it is important to involve all executive users in the process, not just the executive sponsor.

Prototyping Approaches.

Early prototyping should be used to help decide on the basic look and feel of the system. Two fundamental approaches should be presented:

- A full-screen interface with large buttons and icons.
- A multiple window interface with pull-down menus and dialog boxes.

The first approach might be less intimidating, but the second approach conforms to the popular interface design standards. The preferred look and feel should be used to finalize the development environment that will be used (e.g., Windows), as some development environments might more easily accommodate one or the other type of system. In addition, differences in preference for the look and feel may signal the amount of individual tailoring that might be required for each executive.

Although rapid prototyping and extensive user feedback are quite important, the prototypes do not have to be computer-based. Paper screen mock-ups (i.e., storyboards) can be quite effective because the executive can review the screens as time permits and consider the alternatives before providing feedback to the designer. Computer-based prototypes, however, are more useful when showing the executive the potential of the technology and when exploring navigation approaches the executive might prefer.

Executives also must be involved in the design of the interface because their preferences for screen prototypes can provide clues about the importance of screen content and design. This aids a designer in uncovering additional information requirements. By observing the relationships among importance of data, the level of detail desired, and frequency with which the information needs to be called up, a designer better understands the way an executive will actually use the EIS.

Because of the almost endless number of possible screens that can be provided, the designer must narrow the number down to the most important screens for each executive. This not only reduces development time and system overhead, but also makes it possible to provide a system that makes it easy for the executive to find the information that is actually needed.

Any later changes to the interface of an EIS should be discussed with its users. This is especially true when a designer considers deleting seldom-used screens. It is not easy to tell the value of a particular screen just by tracking usage. An executive may have looked at a particular screen only once, but that screen could have provided critical insight that day.
Months later, the same screen might be needed once again when the same critical need arises.

**Setting Standards for Screen Layout, Format, and Color**

Currently available EIS software offers an array of screen design alternatives. Screens can display graphs, tables, and text in hundreds of formats and colors. Unfortunately, this cornucopia of choices sometimes tempts the designer to use many of these alternatives to add sizzle to the screens. In actuality, it only leads to the creation of displays that are confusing. Designers should carefully develop screen design standards that use only a few layouts, formats, and colors.

The EIS at Lockheed illustrates the use of screen design standards; a sample screen is presented in Exhibit 1. The top of the screen presents the screen number, a title for the screen, and the date of the last update. The right hand corner gives the names of those who are knowledgeable about the information and their work telephone number. This information makes it easier for users to go directly to the person who is best able to answer any questions about the information. Some EIS allow users to click on the person’s name to have the telephone number dialed automatically.

**Sample Screen from the Lockheed Aeronautical Systems EIS**

**Layout Standards.**

Lockheed’s standard layout is to present graphical information at the top of the screen, more detailed tabular data below it, and textual information at the bottom of the screen. The graph provides a quick visual presentation of a situation, the table gives specific numbers, and the text provides explanations, assessments, actions being taken, and other such information.

**Graph Standards.**

Graphs of historical and current data always use bar charts. When actuals are compared against plans or budgets, paired bar charts such as those shown in Exhibit 1 are used. The bars are of different widths to allow users with color perception problems to correctly identify each bar. Projections into the future use line graphs. Pie or stacked bar charts are used to depict parts of a whole. On all charts, vertical wording is avoided and abbreviations and acronyms are limited to those on an authorized list. All bar charts are set to zero at the origin to avoid distortions, scales are set in prescribed increments and are identical within a subject series, and bars that exceed the scale have numerical values shown.

**Color Standards.**

Lockheed’s EIS uses only a few carefully selected colors. Yellow is used to show actual performance, cyan (light blue) is used for company goals and commitments to the corporate office, and magenta represents internal goals and objectives. A traffic-light pattern is used to highlight comparisons: green is good, yellow is marginal, and red is unfavorable. For example, under budget or ahead of schedule is in green, on budget or on schedule is in yellow, and over budget or behind schedule is in red. Organization charts use
different colors for the various levels of management. Colors have been selected to minimize color differentiation problems—about 6% of all men and less than 1% of all women have color perception problems—and all displays are designed to be effective with black- and-white hard copy output.

Standard layouts, formats, and colors offer many advantages. They provide a consistent look and feel for the system. Users are less likely to misinterpret or misunderstand the information presented. Less cognitive effort is required, as is the time required to understand a display.

**Use of Text.**

Textual material is entered by the EIS support staff to make the information displayed more useful. The information itself may not reveal the full story, but the purpose of the commentary is to add value to the information displayed. Although Lockheed's EIS presents commentary information on the same screen to which it applies, other EIS place it on a separate screen.

The power of textual commentary can be powerful, as is illustrated by the following example from Lockheed. Both a graph and tabular data indicated that actual cash flow was below budget by $20 million. A commentary revealed, however, that payment for a plane in the amount of $20 million was en route from a foreign country and would be in a Lockheed account by the end of the day.

**Voice Annotations.**

A few EIS allow voice commentaries to be associated with screens. This is an appealing feature because executives are used to receiving information verbally and voice is richer for communications than printed words. Voice annotations to screens is currently the best accepted of the multimedia enhancements to EIS. Other possibilities such as video and personal teleconferencing have good potential, but the business case for them has yet to be made.

**Using the System Should Be Intuitive**

Ideally, an executive should be able to use an EIS without training. At the most, no more than 15 minutes of instruction should be required to teach how to use the basic information-retrieval capabilities. Systems more complex than this are unlikely to be used.

Most successful EIS are operated by point-and-click technology. By picking from among menus, icons, or buttons, an executive navigates through the system to a desired capability (e.g., E-mail or information). Experience with Decision Support System has shown that most executives will not use a command language with a verb-noun syntax because it is too time-consuming to use and difficult to learn and remember. 62

In one easy-to-use EIS, 35-inch monitors were installed in executives’ offices; each can simultaneously display up to 10 windows of information. What is shown is customized for each executive and varies with the day of the month. This EIS is essentially a ticker tape of relevant information.

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Forgo User Documentation.

Systems developers are typically expected to write user documentation for new applications. However, this is usually unnecessary or inappropriate for Executive Information System. The system should be sufficiently intuitive that instruction manuals are not needed. Even more so than with other types of users, executives do not read documentation. If an executive is having a problem using the system, it is best if the user calls the EIS support staff to correct the difficulty.

If users request documentation, it should be provided, either within the system and or in hard copy. Ideally, the instructions should fit on a single page or a few screens. (One word of warning: the fact that there is no need for user documentation should not be confused with the need for system documentation, which remains very important.)

Adhering to Standard Definitions of Terms

Most organizations have data dictionaries that include definitions for the data elements used in Transaction Processing applications. There are other terms that are widely used throughout organizations and are important to EIS that are not as precisely defined. Everyone in a company uses these words and has a general understanding of their meaning but slight differences exist and can cause misunderstandings.

For example, the term sign-up at Lockheed had different shades of meaning. A sign-up involves a company interested in purchasing an aircraft. To marketing personnel a sign-up occurred when customers said they were going to make a purchase. The legal department, however, recorded a sign-up only when a signed contract was received. Finance waited until a down payment was received. Each group generally knew what the term meant, but slight differences based on their organizational perspective led to timing differences as to when a sign-up was recorded. Because an aircraft can cost between $20 million to $30 million, such differences can result in considerably different impressions as to how the organization is doing. A sign-up has now been defined as a signed contract with a down payment.

A Data Dictionary.

Lockheed has an executive data dictionary that contains definitions for all of the terms used in its EIS. The definitions can be accessed through the EIS and is available to all users. Creating an executive data dictionary is useful because it makes executives consider what terms are being used inconsistently and to develop definitions that reflect an organizationwide rather than functional-area perspective.

Designing the Main Menu as a Gateway

Most organizations have a variety of applications designed to support executives: E-mail, electronic filing, decision support, and access to external news and stock prices. Many of these applications require their own access procedures and passwords. This requirement poses some difficulty and inconvenience and discourages hands-on computer use. The development of an EIS provides an excellent opportunity to deliver all of these capabilities in a single, integrated system. An EIS provides the logical and physical umbrella under which all of the executives' computer applications are placed.

A number of EIS used their main menus to display all information and applications available through picks (i.e., menus, icons, or buttons). The kinds of information usually
provide one set of options. For example, there may be screen picks for financial, production, marketing, and human resources information. Separate picks may exist on the basis of products, geographical location, and organizational units (e.g., corporate, division). The choices reflect the information contained in the EIS and how it is organized. Lower-level menus let users move to specific information desired within a general category. Access to these applications should be transparent to the user and not require any additional log-on procedures or passwords; these activities should be handled automatically by the system.

**Designing the System for Ease of Navigation**

Vendors' demos often show executives moving easily through a system, looking at current status information and drilling down to more detailed information when a problem or item of interest is identified. This scenario is possible in practice, but only if careful attention is given to navigation issues early in the system's design.

Navigation problems may be masked when there are few screens in the system. As the number of screens grow, as they inevitably do, users find it more difficult and time-consuming to move through a system. For example, an executive is looking at financial information and wants to move to operational production data. In a poorly designed system, the user will have to back out of the financial application, screen by screen, until the main menu is reached, and then enter the production application, and move through screens to the desired information.

The starting point in designing navigation for an EIS is understanding the mental models that executives have of the organization. If the structure of the information does not match their mental models, users will have a difficult time finding the information they want. For example, do executives look at the firm in terms of geographical location, products, functional areas, or divisions? Each view of the organization may call for a pick on the main menu and a set of related screens.

A complicating factor is when one or a few executives have unique mental models. During the development of one EIS at a hospital, designers found that the director of nursing wanted information structured much differently than other users. Her view of the hospital could be accommodated but required custom designing the system for her use. The decision of whether to do this was a business rather than a technical one.

**Navigation Features.**

There are features that can be included in an EIS to make navigation easier. Some systems have a screen that shows where the user is in the system. Often users get lost and are uncertain about how to move elsewhere, short of turning off the system and starting over. Another feature is to have a home key or pick that takes the user directly back to the main menu. Some systems provide a retrace capability that allows users to easily backtrack to screens viewed previously. Another helpful feature is to include a pick on the main menu that takes the user to a screen that lists the user's most popular screens. From this screen, a user can go directly to any screen on a personalized menu.

Also, a single menu can be created that provides direct access to a large number of screens. For example, a company has five plants; each produces 20 products and there is work-in-process and finished goods inventory. The various combinations result in 200 screens (i.e., 5* 20 x 2 = 200). A single menu where the user picks the plant, the product, and the type of inventory provides direct access to the desired screen.
Lockheed switched recently from custom developed to commercial EIS software. Before Lockheed signed the contract, however, the vendor had to agree to support keyboards as an input device to the system, largely for navigation reasons. Lockheed's executives were accustomed to point-to-point navigation in the system. Each screen could be accessed from any place in the system by simply entering its screen number. Most executives remembered or kept a list of the screen numbers of their favorite screens.

**Response Time as Fast as Possible**

When incorporating text and graphics, internal and external data, hundreds of individually tailored screens and views, and multiple navigational paths through the system, EIS developers must continually monitor the response time of the system. Executives are intolerant of slow response times. A recent survey of Executive Information System development practices found that response times for EIS had actually degraded from an average of 2.8 seconds in 1988 to 5.3 seconds in 1991, despite the increased use of powerful desktop computers and local area networks. Although the same survey found satisfaction with ease of use and the effectiveness of the EIS to be relatively high, satisfaction with response times was extremely low.

Response time problems can be anticipated when the EIS must dynamically build a screen each time it is requested by searching corporate data bases. Response time can be much faster if the screens are static and updated each night, though designers must evaluate the trade-off between timeliness of data on the screens and response time. Response time can also be affected by the narrow bandwidth of today's networks.

**When Speed Counts.**

Generally, executives expect very fast response times when flipping through their usual set of screens each morning. One EIS developer suggested thinking of the maximum acceptable time to move from screen to screen as the time it takes the executive to turn a page of *The Wall Street Journal.*

Executives can usually tolerate a slow response to ad-hoc queries. When an executive is used to waiting several days for the staff to gather information for a specific question, several minutes may be an acceptable wait for directly retrieving the same information through the EIS. The differences between predefined screens and ad hoc query screens should be made clear to the executive, however. In either case, when any system function takes more than a few seconds, a message should always provide feedback that the system is processing the executive's request.

**User Preferences May Change**

Almost all aspects of an EIS, including the user interface, change in time. Several examples illustrate this point. So much information is displayed on a screen in the Lockheed EIS that a first time viewer may be confused by all the information presented. However, this is what Lockheed’s executives prefer. They want information on a single screen rather than having to page through several screens to get the same information. This approach also better supports the making of comparisons, such as when an executive wants to check graphical against numerical presentations of data.

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Lockheed's screens were not originally designed this way; rather, they have evolved in response to executives' requests. This same phenomenon has been noted in other, but not all, organizations as their EIS have matured.

Often, organizations developing an EIS order touchscreens for technophobic executives. These users quickly discover the disadvantages of touchscreens and also find that using a mouse is easy after a little practice. Although touchscreens may help sell the idea of an EIS to some executives, these executives will probably prefer mouses eventually.

As an EIS evolves, the number of its users usually increases. Quite possibly, training given to first-time users will have to change. For example, more time may have to be spent discussing how to interpret the information presented on the most complex screens.

Another approach is to include less complex screens in the system. This was done in one manufacturing firm where the new CEO had a strong background in engineering and production but was relatively weak in finance. Recognizing this fact, the EIS staff developed a number of simple screens that displayed key financial information. As the CEO became experienced in finance, the special screens were phased out of the system.

**Conclusion**

The most important thing to remember is that from a user's perspective, the user interface is the Executive Information System. Most users care little about which hardware or software is used, where data resides, or which communications protocols are used. Rather, EIS users focus their attention on what they must know in order to use the system, how the system's actions are directed, and how the system's output is presented. If executives have to spend much time learning to use the EIS or finding the information they need from it, they will not use this system. To make sure that executives will use an Executive Information System, developers must pay close attention to the user interface. The eight guidelines discussed in this article will help.

**Bibliography**


**Author Biographies**

Hugh J. Watson

Hugh J. Watson is the C. Herman and Mary Virginia Terry Chair of Business Administration at the University of Georgia in Athens GA.

John Satzinger

John Satzinger is a member of the MIS faculty at the Terry College of Business at the University of Georgia.
**Comments**
Favorable variance primarily due to two additional Hercules sales