DEVELOPING AN EXECUTIVE INFORMATION SYSTEM
Kimberly M. Deutsch
National Science Foundation

Building an Executive Information System (EIS) is not like any other software development effort. If you are developing a payroll system, you know the requirement is paying salaries and benefits. What about an EIS? What is its purpose? Is it just your standard reports with color graphics? Sort of cartoons for executives?

An EIS is more than just another pretty user interface. Years ago computer systems were transaction-based. They recorded the input and output of your company. To provide managers with information for decision making, hard copy reports were produced. However, the data was often stale and required the managers to do their own analysis. In response to information demands a new type of system with integrated analysis and presentation was developed — a decision management or EIS system.

A successful EIS answers the basic question, "How are we doing?" This question can be difficult to answer particularly in government where the normal measures used in business to track profitability and productivity do not apply. The National Science Foundation (NSF) is such a government agency. Our product is "Research Funding." NSF promotes and advances science primarily through grants to research institutions. How can we measure our performance? How do we develop an EIS that can help us achieve agency goals?

Step 1 — Assure Proponency
Obtaining authority is key to the success of any EIS. If left to themselves, managers would define their own performance indicators, and in terms of what makes them look good! This can be disastrous should upper management believe the fantasy! Honest and trustworthy as they may be, chickens should not be relied upon to count their eggs. The problem is not just what to measure but who is going to develop the indicators. And where are they going to get the authority to apply them? Solid upper management commitment and support are essential.

Four years ago at NSF the CFO tasked the budget office to develop standard information definitions for Foundation performance indicators. The indicators would show the effects of NSF funding and how the organization was progressing toward agency goals.

The CFO wanted the indicators presented in a timely, user-friendly, menu-driven fashion. An EIS for sure! The EIS would be NSF’s official source for statistical benchmarks and trend data for proposal and award information. Any budgetary or trend information authorized for release would need to be consistent with data presented in the EIS.

Expect your EIS to be constantly challenged as it reveals weakness as well as strength. We are frequently asked to explain our definitions and calculations. Some NSF offices have even hired contractors to develop their own decision-management systems so they might control the indicators. Your EIS needs high-level authority or managers will continue to define their own indicators. No matter how pretty its face, your EIS will live a useful life only as the authority of management suffuses it.

Step 2 — Hire an EIS Staff
The CFO wanted the EIS staff close to the budget and financial analysts and to have direct access to important NSF issues. Being close to the central pulse of the agency helps the staff to understand the issues from the same perspective as the system's proponent — upper management.

The nature of NSF’s performance indicators required an in-house staff. Remember, these are not typical commercial business type indicators. We needed experts in the Foundation’s business.

The "experts" also needed to be computer people. The information for the indicators would come from databases designed for transaction processing, not information retrieval. Navigating through complex corporate data structures is often the biggest challenge for EIS developers. So with a lean staff of three (a supervisor and two programmers) and high-level proponency from the CFO, development began.

Step 3 — Develop Performance Indicators
The first step for the EIS team was to develop the indicators. The team modified some existing indicators and defined some of its own. Using one of the modified indicators, we will illustrate the next stages of our EIS.
To be useful, performance indicators must depend upon factors than can be controlled, such as the annual level of support. In the past, annual award amounts were calculated on the dollars obligated in a particular fiscal year, without regard to the duration of the award. This method was adequate for purposes of fiscal accounting. From a managerial viewpoint, however, it did not incorporate the business rules of the agency into the EIS application.

\textbf{Trend analysis} shows changes over time. Looking at trends over fiscal years was a logical way to present Award Size Duration. But for how many years? Since the agency was established? This would create mountainous amounts of data and burn hours of CPU time. We chose the past ten years.

\textbf{Step 5 - Choose Development Tools}
Choosing the development tools was the next important step. The tools will greatly affect response time, programmer skill level, implementation time, future growth, system flexibility and ease of use. A variety of applications and software tools were available. Packaged EIS software applications provide sophisticated development tools.

- However, notice the sequence of steps 4 and 5. If you select your development tools before you decide how to present the indicators, you can easily get boxed in. Use your tools to develop, not define your EIS.

At SUGI 16 in 1991, Dr. Jim Goodnight, President of SAS Institute, presented SAS's packaged EIS system. He pointed out that most EIS systems focus on the user interface. An EIS is more than just this interface.

In a parody of the Titanic hitting the iceberg, he illustrated his point. Other EIS systems were represented by the Titanic. The iceberg was the SAS iceberg! It does not look like much above the water but underneath it is massive. All the power lies below it unseen. The Titanic has all its power above and not much below the surface.

We developed our EIS before Dr. Goodnight gave this fitting illustration of what an EIS should do behind the interface. We wanted the power Dr. Goodnight would talk about a year later.

We first did some prototyping, exploring different possibilities and even had SAS Consulting Services write a sample EIS using SAS AF and SAS SCL. Prototyping helped us understand how to implement features. It also gave users a chance to comment. The effort and cost of assembling and maintaining packaged EIS applications dissuaded us from using these applications. We decided to build our own system. Base SAS was chosen as the development tool for the extraction and analysis part of our EIS.

\begin{footnote}

Interactive Systems 415
\end{footnote}
Step 6 — Select the User Interface

Now that we had the base, we could focus on the tip of the iceberg -- the interface. We wanted several functions:

1. Transparent data access. If access is not transparent, the EIS will fall rapidly into disuse.

2. Quick response time. Slow response times frustrate users and seriously compromise otherwise effective EIS designs.

3. Graphic Interface. EIS systems usually can represent data graphically. While graphic presentation is a critical EIS component, NSF's terminal emulation software for PCs did not, at the time, support graphics.

4. Easy to Operate. The EIS should be simple enough for a novice user to operate most major features without documentation. Detail explanations of various features would be offered in the on-line Help.

5. Easily Expandable. The team needed to be able to respond to users and changing needs quickly, therefore, they needed software that is easily expandable.

6. Flexible. The user should be able to see different cuts of the data. This would meet our requirement for showing categories and sub-categories.

Step 7 — Program It !!!

The EIS team liked working with the base of the iceberg so much they chose to build the user interface with SAS too. With SAS they could easily control the system's appearance and features. This is the main menu of our EIS system:

Block mode in SAS SCL is great for developing a main menu and having it invoke the user's selection. The program can display a module or call another menu. For example, the user picks Trends and another menu appears:

Notice one of the selections is for the performance indicator we have been working with in this presentation, Award Size Duration. When the user picks this box, the following screen appears:

Two screens showing as one appear. The bottom screen displays the data using the extended table feature. The top screen controls navigation. Only valid function keys appear. Since the highest level of the organization is being displayed, function keys to drill up or across the organization are not shown. The user can drill down to
the next level in the organization by pressing F6 as shown below:

Behind the scenes a SQL query on the staging data gets all the distinct directorate names. A DATALOGIC then executes so the user can select a particular directorate. These steps make the EIS data driven and cut down on maintenance. Users do not have to know any codes or enter any information. The EIS displays only analysis for which it found data in the transaction system databases.

After drilling to the next level of an organization, the user can press F12 to see the raw data used in the calculations. This data comes from our staging area for fast response time.

In other modules, data can be shown in a variety of dimensions using point and shoot. Our EIS has two different point and shoot capabilities. In another module (BLIP or Budget Line Items), the user sees all the major line items on the first screen. For a further break down, the user tabs to a heading or column and presses enter.

For example, if the user selects Personnel, the amount of money under this heading is broken down into various line items. This type of point and shoot allows the user to see the data in logical groupings without scrolling through multiple screens.

The other type of point and shoot is by row instead of column. In the FCCSET Activities module, the user tabs to a particular group and presses enter.
For example, the user selects HPCC row and the components of this group appear on the next screen.

<table>
<thead>
<tr>
<th>HPCC Initiatives</th>
<th>1982</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF software tech/algorithm</td>
<td>$79,955.93</td>
<td>$214,000.00</td>
</tr>
<tr>
<td>Basic research &amp; dev.</td>
<td>$2,181,120</td>
<td>$2,181,120</td>
</tr>
<tr>
<td>High perfor computer syst.</td>
<td>$7,603,720</td>
<td>$7,603,720</td>
</tr>
<tr>
<td>HPCC-related award</td>
<td>$26,425,694</td>
<td>$26,425,694</td>
</tr>
<tr>
<td>Nat. research &amp; ed. network</td>
<td>$26,425,694</td>
<td>$26,425,694</td>
</tr>
</tbody>
</table>

Such flexibility to show data in a variety of dimensions is very easy to implement with SAS SCL using options on the general attribute screen.

We also developed our own help system displayed by pressing F1. The user tabs to a topic and presses enter.

While the topics are consistent throughout the EIS, the SCL help program receives the calling module's name as a parameter and then displays the appropriate CBT screen. The following screen displays when the user selects Purpose while in the Award Size Duration module.

Step 8 - Look to the Future
While our EIS system has been very successful and has been well received, we think of it as an aberrant teenager in terms of "application years." It is very well behaved. It does most of what is expected of it most of the time, but it would be a shame if it stopped growing at its current level. We see the need for the following improvements:
Dependability -- Emulator software used to reach the mainframe freezes or crashes PCs often enough to irritate users. While we have no control over this software (it is selected by our IS directorate), anything the user needs to get to the EIS is associated with it. A survey of our users last December revealed that dependability was the most common complaint about the EIS.

Speed -- We once had a response time of a few seconds between screens. As more of our transaction systems are moved from a HP to the IBM response time is slower.

Multi-dimensional views -- The user can only see the data in a certain combination -- one organization level and one organization at a time. The user needs to be able to transpose or recombine the information. For example, the user would like to select all organizations at one level for a particular year.

Graphics Capability -- Seeing data graphically is easier and faster to interpret than data in a report format. Cost prevented us from using an emulator software that supported graphics. The 3270 environment is not an optimal graphics environment. It is slow and has limited colors and features compared to the PC and MAC environments. We would also like to graphically display multiple indicators on the same screen.

Hard copy -- Screens and reports need to be printed on local printers where the user can get to them quickly and can control formatting.

Download -- Current download procedure is very difficult to use and complex because it supports multiple types of emulator or gateway software -- Rabbit, Rumba, and Telnet. Having the EIS in the PC environment would make this procedure simple.

Mac Compatible -- The IS directorate requires all applications to support both Windows and Macs since about 300 employees are using Macs.

To address these issues, we have decided to move the staging area data to a database on a PC file-server. Then develop a new front end for the user's machine using another product. This process is not easy. PC technology is constantly changing. New and better packages keep appearing. Most of this software also has a steep learning curve.

We are currently experimenting with SAS for Windows, Open EIS by Microsoft, and Foxpro. Each package has its own strengths and limitations. The challenge is to minimize the second without sacrificing the first.

Summary
You have seen the basic steps to our EIS:
• Assure Proponency
• Hire an EIS Staff
• Develop Performance Indicators
• Determine How to Present the Indicators
• Choose Development Tools
• Select the User Interface
• Program It
• Look to the Future

A useful EIS is constantly growing not just because of technology but with current policy issues. Developing an EIS is an exciting and demanding effort. The payback is quickly recognized. Hopefully you can start developing your own EIS soon.