PROTOTYPING LARGE SYSTEMS USING THE SAS SYSTEM

Stephen C. Martin, Westinghouse Electric Corporation
Robert M. Moreau, Westinghouse Electric Corporation

Prototyping of large and complex computer applications may become the most popular and effective technique that will be used while defining and developing new applications. The formal methods of developing computer applications utilizing bulky or lengthy system analysis documents, structure charts, pseudo-code, detailed program specifications and repetitive review processes are becoming outdated very quickly. These techniques of communicating the details of a computer application have proven to be very lengthy, costly and inefficient. Prototyping advocates development of a quickly modifiable system that is refined through an interactive process during the definition and development of a production system.

Traditionally, prototyping was used for system testing and user acceptance at the end of large projects. Currently, these techniques are being used during both the first phase of a development project and through all subsequent phases. The success of any system prototype depends on the flexibility of the software. The SAS System provides the necessary tools to build and use prototypes that potentially can be expanded into production systems. The SAS system becomes a good choice to use because of its ability to quickly and easily modify data storage structures, create and integrate system menus, build screen definitions quickly with minimal programming effort, create reports and graphics with ease and most important, the SAS System is integrated and supported by one vendor, the SAS Institute.

System developers are motivated to satisfy user requirements, but the traditional methodologies often work against the success of this effort. Prototyping is based on the assumption that a complete set of user requirements can never be completely established until the user has a chance to experiment with and use a working model of the system. Since the development of these requirements will be ongoing throughout the project, the software supporting the prototype must be simple to modify and flexible enough to add new requirements regardless of when they are discovered. The SAS System will perform both of these functions.

The first step in developing a prototype is to define the functions that the new system should perform. These functions can be at a very high level such as data entry, reports, data analysis, online inquiry features and graphics. With these functions identified, the SAS Macro product can be used to develop menus which will prototype transitioning between the functions. There will always be a main menu followed by subordinate menus. All required system functions are placed on the appropriate menu within the hierarchy (See Figure 1 for example).

Below is the source code and the resulting display for this functional menu.

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The appropriate level of menu nesting depends on the size of the application and the practical limits to the nesting. These limits will be identified as the user becomes impatient with having to step through too many menus. The Macro product is flexible enough to handle this heuristic definition/development technique. It not only can be used to handle the menu displays and transitioning between them, but it also creates the framework to add on the necessary software to actually support the functions.

Once the functions have been established, the data required to support them must be defined. This is often simple to do because the user generally has some form of data entry documents, reports, paper files or other miscellaneous documents that are used during the day-to-day work environment (See Figure 2 for data collection example). The systems analyst can then group the data into logical SAS data sets which will be used to support the functions defined in the menus. SAS data structures, because they allow quick modifications regardless of data record management (file definition, chains, pointers, key, and indexes), support this process extremely well. The ability to quickly modify the logical SAS data sets makes SAS data management techniques an excellent choice to be used for prototyping.

Figure 1. Functional Menus
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The next step in the prototyping task is to integrate the appropriate SAS data sets with the functions on the menus. Once again, the Macro product makes this integration efficient and simple. One required business function usually is some form of online data entry. Once the data are available through the menu, the systems developer and the systems analyst can then build the data entry screens using the Full Screen Product product. The system developer can create the screen together so they can define such SAS data sets with the functions on the menus. Once the screen is completed to the user's satisfaction, it can then be tested to see if it works as planned. Since the screen has a SAS data set integrated with it, the user can take the data entry documents and enter the data as if it were a live environment. Changes are made as required until the user is completely satisfied. The beauty of this process is that the user is able to "test drive" this portion of the system and becomes comfortable with how it works. The process would then be repeated for any other data entry screens (see figure 3 for example).

Other functions from the menu probably will include various online inquiries of the user's data. There could be many users utilizing the information, each of whom want to view the data differently. The analyst can define the inquiry screens with the different users exactly as was defined in the data entry process using the Full Screen Product product to build, modify and finalize each required inquiry screen (see figure 4 for inquiry example). Once defined, they would then be integrated into the menus using the Macro product. After the users are exposed to this process and become comfortable with it, they can independently define and build their own screens. The systems analyst's role will be limited to integration of the screens into the menus after their definition.

If reporting is required as a necessary function of the system, this too can be integrated into the menus using the SAS Macro product. Reports can be written utilizing SAS which will allow for quick modifications and data manipulation. Since the data that will be inputted to these reports have been logically grouped earlier and refined during the data entry and online inquiry definitions, most reports required should be easily defined and quickly written. A generic report writer facility could also be explored if the reporting requirements are extensive. If a report takes more than two hours to write, the logical groupings of the data should be reviewed.

If online graphs are required as a necessary function of the system, they can be facilitated using SAS/Graph product. The SAS/Graph product is completely flexible as to the esthetics of the graph and will support any graphics requirement. The analyst can work with the user(s) requiring the graphics and build, revise, modify, and finalize each online graph. These graphs can then be integrated into the menus using the SAS Macro product. The analyst will discover that the graphics development will take a little longer in definition because the users will "play" more with the different parameters of the product. One online graph typically takes two hours to develop.

Once all functions on the menus have been either satisfied or reserved for future enhancements, the user and the systems analyst will have a working model of what the system should do. The users are comfortable because they have been able to review the system "hands on" and the systems analyst is comfortable because he has a "blueprint" of what the ultimate system should look like and how it should work. The entire prototyping process, even defining large, complex computer applications, should take approximately one to four months.
The prototyping process changes the existing roles of the analyst and user. Traditionally the user generates requirements which the analyst must interpret, design, code, test, and then review with the user. Most likely, there will be modifications to the original requirements and the analyst will be doing "re-do" work before installing any software. Prototyping will have the user "building" the system and doing the "re-do" work himself, where the analyst will be performing a technical integration role of the users functions.

Some education and guidance may be required when dealing with users who are not familiar with prototyping and are uncomfortable with computers. A project plan detailing the prototype definition and its deliverables, as well as the production system development, is a must. It is also a good idea to make sure the user understands exactly what the prototype is and that a production system will not be viewed, but only a preliminary suggestion of how the system might look. A review and approval schedule should be negotiated with the user at the beginning of the project.

System development proceeds at a quick pace throughout the creation of the prototype. Utilizing all the SAS System, the prototype has been expanded and modified to accommodate newly-discovered requirements until the user is satisfied with the current version. It is now time for the analyst to prepare the detailed specifications of the production system. If done carefully, they will be correct because they have been derived from the functioning, user-developed prototype.

The analyst might even find that the production system that is being developed can be facilitated using the SAS System. This is quite possible depending upon the complexities of the system interfaces, system requirements, and the company's data processing standards. In any case, the analyst has an excellent start at developing a production system and a working model of that system to define future enhancements.

Prototyping large computer applications will eventually replace the current paper driven methodologies. It will have the following positive benefits: short overall system development time, more accurate determination of user requirements, greater user participation and support, less threatening process to users, and potentially shorten the backlog of systems waiting to be developed and implemented. Each systems development area must choose the software that they would like to utilize during prototyping. Good prototyping tools are based on providing a development environment where "what you see is what you get." This implies the use of online-oriented software where formatting can be accomplished effectively and system functions can be specified through menu selections. It is also important that the software allows new data elements to be added and old ones deleted without concern over data paths and data management. The SAS System responds to all of these prototyping requirements. They are simple to use, well documented, becoming more and more popular, and run on an extensive list of hardware. So review your systems development methodologies, include prototyping within them, and develop better defined, quality systems that will be used by a happy and satisfied user population.

The following are examples of prototyping a functional menu, data definition, display generator, data entry, data inquiry, and report/graphics generator.

For additional information concerning prototyping using the SAS System, contact Stephen C. Martin or Robert M. Moreau at (201) 765-1070.