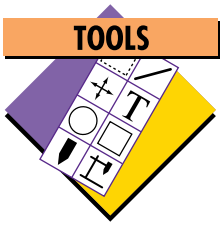
VSM: A User-Centered Design



By Georgia A. Gibson

This article shows how an IBM team followed a user-centered design process to create a first-class product family for AIX system administrators. As developers of IBM's Visual System Management product family, we learned to appreciate and encourage the individual contributions of each team member. This mutual respect combined with our user focus resulted in a quality product.

Usability of products, a characteristic once important only to users, is now recognized as a feature that results in good business. As you thumb through your favorite computer software magazines, you will notice how frequently terms that describe ease of use are used to differentiate a product. Although customers have asked computer companies for years to make products easier to use, the business side of companies is just now beginning to realize the customer appeal of usable products and the great profit potential.

The User-Centered Design Approach

The heart of a User-Centered Design (UCD) process is a multidisciplinary team following a disciplined user-based process to develop a product "from cradle to grave." Our IBM team followed this UCD model to develop Visual System Management (VSM).

The VSM Product Family

The VSM product family of icon-based, object-oriented Graphical User Interfaces (GUIs) was developed for AIX system administrators. (See "the Next Step for Visual System Managment" in this issue.) It now consists of the following applications:

- Users and Groups Manager
- Device Manager
- Storage Manager
- Print Manager
- Install and Update Software Manager
- Maintain Installed Software Manager
- Easy Install
- Install Assistant

The first four applications were released as a separate package with AIX 3.2.5. The rest of the family was introduced with AIX 4.1.

Since the concept behind VSM was initiated by usability requirements from customers, we started the projects in our AIX Human-Computer Interface (HCI) department, which is primarily concerned with usability, user interfaces, and other customer advocate issues. At the inception of the project, there were two HCI teams—each consisting of one member with traditional human factors skills, one graphics designer, two human factor team leads, and two prototype software engineers. These teams worked together to develop different areas of the VSM project. The system management team focused on the Storage Manager, Device Manager, Users and Groups Manager, and Print Manager, while the install team concentrated on Install and Update Software Manager, Easy Install Manager, Maintain Installed Software Manager, and Install Assistant. These two teams are referred to as one HCI team in this article.

The system management team began working with Storage Manager and the Users and Groups Manager to determine basic metaphors, user mental models, and screen layout issues. Next, the install team began developing their applications. At the height of the project, the department was working on eight new products simultaneously in a collaborative process.

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The Overall Team and Their Roles

We took a multidisciplinary approach to the design of VSM. The cross-functional team had representatives from the following areas:

- **AIX Software Planning**: The planners assisted in the design by conducting periodic customer councils and providing requirements that fed into the initial designs.
- **AIX Human-Computer Interface**: The HCI department owned the product designs, conducted rapid prototype testing, produced multiple prototype designs, validated metaphors and screen design, documented the designs, followed through with software engineers, conducted User Integration Testing (UIT), and produced announcements with the marketing group.
- **AIX Information Design and Development (IDD)**: The IDD team, which consisted of a team lead and one writer per application, was responsible for the online help design. They were brought in during the design phase to implement the basic concepts and objectives of the design. They collected data in the usability testing efforts and were heavily involved in all stages of the product development, which helped them to design and produce online help, softcopy information, and hardcopy documentation.
- **AIX Software Development**: The Software Development team, consisting of a team lead and one software engineer per application, was also brought in during the design phase. The Software Development team acted as consultants on design and implementation issues. Their participation in this phase familiarized them with the objectives and designs that they would later code.
- **AIX System Management Architecture**: Members of the System Management Architecture group consulted on task domain specialties, such as Logical Volume Management (LVM). From the inception of the high-level design, the User Interface (UI) architect led the GUI widget library team and coordinated the design documentation. The architect's other role was to oversee consistency in the designs of the different applications in the family. HCI, IDD, Product Verification Test (PVT), and Software Development team leads met regularly with the UI architect to resolve issues such as consistency, translation, documentation, and Common Desktop Environment (CDE) integration. These meetings were essential to maintaining open communication between teams.
- **AIX Product Verification Test**: The role of the PVT team was to test the product family after functional verification testing. PVT testing occurred during the implementation phase for product accuracy and consistency across system management families, such as the System Management Interface Tool (SMIT) and VSM. The PVT team started by reviewing the product specification so that each PVT team member would become familiar with the designs at an early stage. Next, the PVT team wrote the PVT test plan, which was reviewed by all team leads for completeness and relevance. When PVT finally implemented the plan by testing the product family, the team also tested online helps and hardcopy documentation for accuracy and consistency across products.

The heart of a User-Centered Design (UCD) process is a multidisciplinary team following a disciplined user-based process.

Disciplined User-Based Process

According to other UCD processes, the disciplined user-based process consists of task analyses, competitive evaluations, high-level design walkthroughs, prototype evaluations, beta surveys, and benchmark assessments. As the following descriptions show, our team followed the UCD process on the VSM development project.

Task Analysis

This phase provides an understanding of future users, their environment, the tasks they currently perform, and the tasks they anticipate performing in the future. In our case, we were interested in learning about the needs of future users of VSM, namely system administrators. Thus, we used the results of an extensive task analysis involving over 100 system administrators[1] that had been conducted for system managers of UNIX operating systems. The study developed job descriptions for system administrators.

The results provided us with information about what tasks were performed by the percentage of the population performing them, and the average time spent on each task. In addition, system administrators rated each task according to various categories—consequences of inadequate performance, time to learn, and task frequency. System administrators also provided information

[1]Gibson, G. A. "System Management: What a Job!" *Proceedings of Share75* 1 (August 1990).

about types of hardware and software used, experience levels, and many other user environment issues and attitudes.

In addition, 57 worldwide customers participated in an AIX system management Quality Functional Deployment (QFD) requirements gathering project.[2] QFD is a systematic process for collecting customer requirements for a product. The collected data was fed into the functional requirements, and user interface and documentation requirements. Each account was profiled, and core QFD team experiences were documented, providing us with an in-depth understanding of our customers and their needs. The information we gained from this project and the task analysis study greatly influenced our designs.

Competitive Evaluation

In conventional UCD processes, this phase involves acquiring a detailed understanding, from a user's perspective, of the design of competitive products. In our case, competitive evaluations were facilitated by IBM's Competitive Evaluation Center (CEC). By using the wide variety of UNIX hardware and software available at the CEC, we were able to conduct heuristic evaluations at a greatly reduced expense.

High-Level Design Walkthrough

This phase defines the high-level design of product aspects seen and touched by users and compares it to that of competitors. We first brought in participants from a sample target population to view sketches and online screen mockups to help us define the high-level design of VSM products. Rapid prototyping techniques iterated the design; design changes were a direct result of this feedback. We changed the design at every iteration until we gained a favorable consensus from the users. The resulting high-level design became a solid basis from which we could develop more design details.

The HCI, planning, and architecture groups then compared this user-centered, high-level design with the competition. Once we all agreed that we knew the basic functions in the product, we were able to further develop the details of the design.

Prototype Evaluation

The prototype evaluation methodology of conventional UCD has two tenets:

- GUIs must be designed iteratively; a GUI cannot be designed "right" the first time.
- Design iterations must involve users—that is, user feedback must influence the design iterations.

Iterative prototyping was first performed at a high level and then throughout the design phase as a result of user testing. Once we had defined the high-level design, we quickly began producing prototypes of each product. Since our project was large and funding came in stages, each product was in a different stage of development; the products were being designed, prototyped, and tested concurrently. We soon realized that we would have consistency problems.

To combat these problems, we instituted "WHIM" meetings to communicate design issues and test results. With everything flying at a rapid pace, all of us were wondering "What Have I Missed" (WHIM). Any team member could call a WHIM meeting, but we also had regular, weekly meetings—sometimes once a week, twice a week, whenever we needed them. We documented the meetings in the product design specification to help us keep track of issues. The WHIM meetings proved useful with many benefits, including good communication lines.

Toward the end of the design phase, we validated the application designs with a traditional usability test and measures. Since the designs were still only prototypes, we defined sample tasks for each application and developed the prototypes to perform those tasks. To test the designs, we brought in users who matched target customer descriptions. We then changed the designs based on the results of user testing. Once changed, we documented the designs in product design specifications. At this point, we had completed over 1,100 hours of user testing.

Implementation Phase

Although this phase is not described in traditional UCD processes, we found it to be a critical part of our process. This was the coding phase, in which designs were converted into "real" products. Designs also changed in smaller ways during this phase in response to feedback from actual users of our applications. The designs became *even more* user centered.

During the implementation phase, the application teams consisted of UI designers, the IDD team, and software engineers. Each application

[2] Ashford, J.; Boschult, D.; Gibson, G.; Kim, G.; Lubart, N.; Rother, D; Smith, M. "UNIX Systems Management Voice of the Customer." *Unite 91 Conference Proceedings* (August 1991).

team met regularly, sometimes every other day, to review the coded design and to discuss design and documentation issues. Defects were documented and tracked using IBM's AIX Configuration Management Version Control (CMVC). We used these forums to discuss any defect or feature that might affect users. These discussions were especially beneficial to our user interface designers because they enabled designers to discuss implementation issues and trade-offs as a team. By participating in the discussions, the IDD team acquired new understanding of the design from the inside out.

User Integration Testing

The UIT phase is an important phase that is not described in conventional UCD processes. By conducting a usability test of the applications using real-code versions and up-to-the-minute documentation, the UIT phase provided additional user feedback to further improve the designs.

Defects were documented and tracked using IBM's AIX Configuration Management Version Control.

During the UIT phase, a PVT team member worked jointly with the HCI team members to test the implemented products. In independent testing efforts, PVT tested the functions and features, while HCI tested the usability of the designs with real users. This collaboration ensured that any design trade-offs had not negatively impacted the usability of the design. The result was a very profitable test of the usability and functionality of both the interfaces and documentation designs.

Beta Survey

The purpose of the UCD beta survey was to gather data from early users of the product before making the product generally available to customers. Typically in a beta program, all product channels are exercised (including service, support, and marketing). VSM also had a beta project in which users of all types used the products in their work. We then incorporated their feedback as product improvements using the CMVC tool.

Benchmark Survey

In the benchmark survey phase, the new product is compared to competitive products. This comparison is performed in a controlled testing environment with users and tasks identified in the Task Analysis phase. Information sought includes competitive advantages, traditional usability testing measures, and early identified usability objectives. The VSM products have not undergone any benchmarking activities to date.

Benefits of UCD

All participants in our VSM development project benefited from working on a cross-functional, user-centered team. First and foremost, we developed a high-quality, user-centered family of products. Individual team members experienced benefits such as first-hand knowledge of customer interaction with the system, early design input, multiple focuses on consistency issues, and close relationships that allowed for quick turnaround on design issues.

The ultimate gain to the product was a high focus on usability, which resulted in high product quality.

The PVT team also reported multiple benefits from working together, such as faster turnaround on problems, early design input, increased ability for software engineers to anticipate usability problems and how to prevent them, and a noticeable difference in the number and type of problems in the products released in IBM's AIX 3.2.5 and AIX 4.1 operating systems.

Because every team member was intimately involved in all stages of the project, each member was able to give impromptu demos or planned presentations of the products. This spread the responsibility of presenting the project to non-team members across organizational boundaries.

Team members gained many benefits through their interdependent experience on the VSM development project. Everyone was encouraged to introduce new ideas and opinions; communication between the teams was open and free-flowing. The diversity of personalities, experience, and training brought multidimensional qualities to the team.

In such an environment of cooperation, the interface blossomed. The result was VSM—a product that hides the pain of system management under designs that are fun and easy to use.

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