TVA WorkForcePlanner (WFP): An Example in Application Development within the Budget

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ABSTRACT

This paper illustrates the effectiveness of the iterative development methodology using a production enterprise-wide application. Budget considerations and the need for user satisfaction are also discussed. In addition, this paper covers the importance of a partnership between client and developer when creating an application such as this.

The Tennessee Valley Authority (TVA) had an immediate need for a workforce planning system that would enable users to enter and analyze human resource forecasts. They also had a limited budget with which to work, but needed to have a system that would provide both user-friendliness and accurate data to satisfy their users' needs. TVA, working in conjunction with SAS Consulting Services Inc. (SCS), used an iterative development methodology to create and implement Version 1.0 of the WorkForcePlanner (WFP) system within six weeks.

The iterative development approach allowed TVA/SCS to continue to create additional WFP modules at the same time the initial version was being used to enter forecast data. Since March 1993, subsequent system iterations have introduced new enhancements and modules to the application. The latest of these enhancements is the conversion of the WFP application from a mainframe system to a client/server application, keeping the data on the mainframe while the application resides in the SAS System under Windows.

INTRODUCTION

TVA is a federal utility which serves seven southeastern states in the Tennessee Valley region. The utility employs a staff of 16,000-plus at corporate offices, nuclear, fossil, and hydro plants around the Valley. In 1993, after several years of downsizing, TVA implemented a formal workforce planning initiative.

As TVA developed a workforce planning process, it became apparent that a decision support system would be necessary. Workforce demographic information, such as average age of employees, numbers of employees in various occupations, numbers of potential retirees, and diversity statistics would be needed to make decisions about the TVA workforce. While workforce demographics information existed in various TVA information systems, it was not readily accessible. The original concept of the WFP application was to put workforce demographics information at the manager's fingertips.

KEY PROJECT DECISIONS

After careful consideration of existing data and hardware, developing WFP as a mainframe application proved to be the most cost effective. The following issues were considered:

- Most existing TVA workstations had mainframe access, not all were personal computers; a mainframe application would not require any additional hardware procurement.
- The TVA Wide Area Network (WAN) was not yet completed making a client/server application very costly for the initial phase of implementation.
- TVA workforce demographics information resided on the mainframe in various information systems; a mainframe application could access this data easily (no downloading, etc.).
- Many users would be accessing the system from remote locations and a mainframe application would be much less costly to troubleshoot.

TVA chose to develop WFP using the SAS System for the following budget-related reasons:

- SAS software and licenses were already in-house, eliminating the need to purchase any software or licenses for the WFP application.
• Rapid prototyping capability resulting in significant time savings.

• Ability to access information in many file types eliminating the need to convert all data to a specific file format.

• Ability to develop a user-friendly, PC-like application reducing the time spent in training users.

• Portability, making it easy to move the application from a mainframe environment to a distributed environment allowing for a future WFP client-server application.

TVA developed the original WFP prototype using SAS/AF® software and Screen Control Language (SCL). This prototype consisted of a main menu, a selection box that enabled the user to pick a particular TVA organization, and a set of screens that displayed information such as the number of employees in the organization, average age of employees, number of employees by occupation, potential retirees, and number of veterans, women, and minorities. A file containing the data for the application was extracted in batch mode each night from the TVA Human Resource Information System and Retirement System databases.

The original prototype was beta tested by managers for ease of use and type of information displayed. Appropriate changes were made before WFP was released making this application well received by users.

As the workforce planning initiative evolved, the capability to enter, roll up, and analyze the human resource forecasts in a standard format became a necessity. Managers also needed the capability to print reports from the WFP application. After determining there were no in-house resources available to enhance WFP, TVA chose SCS to develop the WFP planning and reporting modules for the following reasons:

• Rapid development (six weeks) which allowed for significant time savings.

• Flexibility to implement portions of the modules in conjunction with the workforce planning cycle, while additional development continued.

• Consultants who could work as partners with TVA staff.

THE ITERATIVE APPROACH

The traditional approach to application development has been for the client to give the developer a series of specifications and instructions that describe system requirements. Next, the developer conducts the necessary analysis on the project, generates the screens and programs, and delivers the system. In between, there is generally very little communication between the parties, especially in regard to how the finished product will look.

This approach can become very costly with the time and personnel required to develop and write the specifications, attend meetings to discuss, understand and refine these specifications, and perform the analysis. All of this is done before the actual development of the application begins. Also, changes are not easily incorporated due to strict adherence to the original client specifications. Therefore, if requirements have changed during the development period, there may be additional costs in altering the application during the development process (costs that may not be included in the project's budget) or in subsequent "maintenance" projects, which could include the preliminary steps of defining requirements and analysis.

The alternative to this process is the iterative development methodology or rapid prototyping. This places a version of the application in the client's hands as soon as possible and delivers the application in usable modules to encourage client feedback while development on other modules continues.

By getting a version of the application to the client early in the development process, changes in requirements can be addressed as they surface. These changes can be incorporated into the normal development process, so the expense of reengineering screens and programs after they are "complete" is avoided.

Another cost and time benefit to rapid prototyping is realized in the definition of project specifications. This approach does not require detailed requirements; it recognizes that requirements change as development progresses and business needs change. This saves the time and expense of writing detailed specifications. This paper demonstrates how this approach to system development was successful in an actual application.

Using this approach enables the developer to deliver a prototype of an application within weeks after the initial specifications are defined. The client then has
an idea of how the application will look early in the development process and any necessary changes can be identified before much work is completed.

While the client is reviewing the prototype, development on additional modules can continue as well as enhancements on the initial prototype. The client can provide feedback on the prototype, and desired changes can be incorporated into the subsequent version of the application. When the second iteration of the system is delivered, it contains revised and functional copies of the initial screens and programs, as well as new modules to be reviewed.

RELATIONSHIP BETWEEN TVA AND SCS

The iterative approach to application development also emphasizes the relationship between client and developer. Communication between the two becomes part of the development process, including client feedback on new prototypes, notification of new or unforeseen needs of the clients, and discussions of design ideas as development progresses. This type of relationship between TVA and SCS has helped tremendously during the development of the WFP application. It has facilitated changes to specifications, priority lists, implementation, and problem solving throughout the development process.

The partnership between TVA and SCS was most evident at a series of continuous improvement meetings in April 1994, where SCS consultants were introduced not as outside consultants, but as an extension of the Workforce Planning staff. These meetings, along with a similar one held in July 1993, helped SCS in two ways. First, they received first-hand feedback from users of the application they developed, including a number of suggestions for enhancements. A number of these suggestions from the 1993 meeting were implemented between July 1993 and March 1994. Second, SCS was able to see how the application and the entered data are used, how the entire workforce planning process flows, and how the WFP application fits into that process.

This understanding has been helpful in developing the later modules of the WFP system. It also contributed to completing the requested changes and enhancements more quickly and within the project's budget. Rather than having to rely on descriptions of the users' needs from a second source, which lends itself to misinterpretation and misunderstanding, SCS consultants were able to discuss these needs and possible solutions directly with the users of the application. This resulted in a lesser number of changes and system iterations in the long run, since the developer knew exactly what the user wanted.

EVOLUTION OF THE WFP APPLICATION

The iterative methodology meshed well with TVA's needs. TVA had a deadline for entering the five-year human resource forecasts and needed the screens within six weeks from the beginning of development. The original SCS prototype included the screens and programs necessary for TVA to view and edit the five-year forecasts, the estimated number of available personnel for each of those five years, and the jobs and departments where they would have gaps or surpluses in personnel for those years. These were developed using base SAS®, SAS/AF®, and SAS/FSP® software. The initial prototype also included two different screens to view/edit forecast data using two methods of data entry/modification. This enabled TVA to see both screens and choose the one they were more comfortable with. Once this feedback was relayed to SCS, they were able to continue development on only the module chosen by TVA. TVA began using these screens immediately to enter the human resource forecasts.

The next system module needed by TVA was reporting. This module would generate reports showing the forecasts and the resulting personnel gaps and surpluses. There were also some changes to the prototype screens and programs. The enhancements and the new printing module were delivered for TVA's review within six to eight weeks after the first version was implemented.

The original budget for this application was $75,000. This included development of the forecast entry/edit system, reporting, and a "What-If" Scenarios module. The iterative development and rapid prototyping approach, combined with the open communication between client and developer that this approach promotes, allowed these modules to be delivered on time and for just over half of the project's budget. This left funds available to develop the many system enhancements discussed at the July 1993 continuous improvement meeting.

A recommendation was made by SCS to consider making use of the latest technology available with the SAS System: FRAME entries and client/server technology. Because TVA's WAN was now in place, additional funds were budgeted for SCS to redevelop the WFP application under Windows (to this point, the entire application had been developed on the mainframe). The data would remain on the mainframe since TVA's other human resource data were still in this environment. The PC version would
take advantage of the user-friendly point-and-click capability and would allow more flexibility in the system’s functionality. It would also include an interactive reporting module, allowing the user to design custom reports.

Specifications for the WFP client/server application were developed as enhancements continued on the existing mainframe version. In December 1994, a working prototype of the WFP client-server system running on the SAS System under Windows was demonstrated. A second iteration was delivered to TVA in January 1995 and will be piloted in the spring. The frequent delivery of system iterations for client review and the constant feedback from TVA have resulted in all development, changes, and enhancements being delivered on time and within the budget.

At this writing, eight iterations of the mainframe version of the WFP application have been delivered since March 1993, along with two iterations of the client/server application. In addition to major releases, there have been numerous quick changes made when a member of TVA’s workforce planning staff would request a minor but immediate change to a module. In many cases, the open communication between client and developer allowed these requests to be fulfilled quickly, often during the phone call to make the request.

CONTINUOUS IMPROVEMENT OF THE WFP APPLICATION

The TVA Workforce Planning staff facilitates WFP continuous improvement meetings around the Valley each year. All WFP users are invited to attend these meetings to contribute ideas for enhancements. SCS consultants are involved, as mentioned earlier in this paper. At the conclusion of these meetings, all ideas are compiled and sent to attendees for input on priorities.

This prioritized list is used to ensure that TVA stays within the budget for the WFP project and yet addresses those issues deemed most important by the users. The priority list has been instrumental in achieving the most system enhancements for the budget dollars available.

After WFP priorities are set, TVA and SCS work together to finalize the enhancement schedule. The WFP enhancements are scheduled for completion before the next annual workforce planning cycle. The prioritized enhancement list and schedule is then sent to those who participated in the continuous improvement meetings. This acknowledges user input and produces a system which meets the users’ changing needs.

FACTORS TO CONSIDER FOR COST EFFICIENT APPLICATION DEVELOPMENT

- Identify existing available hardware and software that is already in-house and can be used with little or no cost to the project.
- Identify existing data formats that will have to be accessed and determine the most cost effective systems approach for using them in their current formats.
- Identify the system users and determine if there are hardware and location issues, as well as any other issues.
- Identify your company’s long-range data systems plans (for example, client/server) and opt for systems moving in that direction.
- Use the iterative approach to applications development; it is far better to succeed in small steps that to fail in one giant leap!
- Cultivate a solid relationship with the application developer.
- Set priorities for system enhancements, with user input, and stick to them.

CONCLUSION

TVA and SCS together have been able to adapt the WFP application to meet the changing needs of the workforce planning process as it has evolved. This system has consistently been on time and within the budget. The keys to keeping a systems project within a budget include:

- Examining what exists in-house that can be used for little or no additional cost.
- Involving users in prioritizing enhancements and sticking to it.
- Using the iterative process to achieve on-going successes as the project is brought to completion.
REFERENCES


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