PRO *CAST: Providing Timely Information to Monitor Progress Toward University Goals

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Integral to the strategic planning process of any college or university is the ability to access timely, accurate information to support decision-making and monitor progress toward established goals. At the University of Massachusetts System, an integrated suite of technologies—an information warehouse with executive information, decision support, and data analysis—called PRO *CAST provides this capability to administrators, planners, and policy setters.

The University of Massachusetts System comprises five campuses—three residential, one urban commuter, and one medical center/medical school. The campuses are overseen by a systemwide Board of Trustees and President’s Office. The five-year goal for the University is to develop the five-campus system as one that will be known by the year 2000 as an institution of academic excellence and one of the best in the nation in terms of responsiveness to state educational and economic needs.

To accomplish this, attention has been focused on four strategic priorities: (1) reaffirming teaching and learning, (2) embracing diversity and pluralism, (3) promoting economic development, and (4) advancing the distinctive goals of each campus. Measurable goals have been set by each campus for the four strategic priorities in order to clearly demonstrate to the citizens and officials of the Commonwealth that the University is making progress in achieving its stated goals.

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The mission of the President’s Office is to carry out the policy of the Board of Trustees in attaining these goals. To that end, the President’s Office has developed its own set of goals, called “strategic imperatives,” which focus on providing leadership during the restructuring process, acquiring the necessary external support, establishing new sources of funding, and ensuring the overall accountability of the University.

University Information Systems (UIS) is a systemwide service arm that supports the information technology needs of the President’s Office, provides wide-area infrastructure support for the five-campus system, and develops and maintains centralized administrative information systems.

Rationale for implementation of PRO *CAST
When the Board of Trustees, president, and campus chancellors began to set goals for the University System and individual campuses, they acknowledged the importance of having timely, accurate information to monitor progress toward the goals. They also realized that there were a number of problems that currently prevented obtaining the necessary information promptly.

Sometimes the data were not available, and this would result in the inability to monitor some goals or respond to external requests for information. When the data were available, it was difficult for the President’s Office staff to locate and collect them from the five campuses. Once the data were obtained, they had to be manually entered into the computer from hardcopy reports. Because the time frame for the information requests was usually very short, this left little time for those preparing the report to add value such as interpretation of the results. It was also a labor-intensive project to look at trends, since the data were usually stored in a number of point-in-time files. In short, the information was not readily available or useful for management purposes.

To address these issues, University Information Systems proposed that a source of well-defined, high quality data be created, along with the appropriate tools to extract the data and present them in a wide variety of formats for the many different constituencies that needed information. Executive information capabilities were required to summarize the vast amounts of information into an easy-to-digest format with eye-catching graphics. Information access by executives must be effortless, so preset capabilities were necessary, along with an option to change any of the settings (e.g., data range, employee type, funding source). Decision support capabilities were also required to allow manipulation of data with “what if” calculations. These features would allow decision-makers and policy setters to model various courses of action. Finally, online analytical processing capabilities were needed to enable institutional researchers to provide combinations of data that were not readily available in the past, and to improve access to trend data. Using a new form of information warehouse, a solution to these needs, called PRO *CAST, was developed.

Overview and architecture
PRO *CAST provides an integrated suite of technologies—an information warehouse with executive information, decision support, and data analysis capabilities—for the President’s Office and campuses of the University of Massachusetts System, and indirectly for the Board of Trustees and the Commonwealth of Massachusetts. The application helps administrators, planners, and policy setters to examine past trends for the University, determine where the University is currently positioned relative to its peers, plan for the future, and measure progress toward the goals that have been set for the University System and individual campuses. Components of PRO *CAST are incorporated into various business processes for nearly eighty managers and staff at the campuses and the President’s Office.

PRO *CAST comprises six components, as shown in Figure 1: information warehouse, easy data collection, encyclopedia, built-in business rules, data transformations, and data delivery tools. These pieces are purposely designed in a modular fashion, using open-architecture client/server, relational database, and networking technologies so that the system is upgradable as technology advances and scalable as University needs dictate.

The information warehouse is housed on a Digital VAX system using both relational data...
base technology (Rdb) and multi-dimensional analytical data structures containing summary and detailed information.

The data in the information warehouse come from various sources, and more information is being added as new business problems are identified that cannot be addressed with existing information. A substantial part of the data currently is obtained from the legacy operational systems—financial records, human resource, and in the future, student systems. Data are extracted from legacy databases through SAS programs and loaded directly to the information warehouse. Other data, such as capital campaign information, are prepared by individual campus users in spreadsheets and also loaded to the information warehouse.

The encyclopedia component contains data definitions, along with notes about the quality of the data and any anomalies the user might find in the data. The extract programs from the legacy systems also provide measures of the quality of the data, and this information is available through the encyclopedia. Historical context is incorporated to assist in interpreting data as they change over time.

Information about business rules (relationships between sets of data elements) is documented in the encyclopedia, as well as built into the graphs and reports in the executive information system.

To facilitate reporting, some data are transformed when they are brought into the information warehouse. For example, detailed data are rolled up into useful summaries. Also, data from the campus systems have inconsistent coding structures, and are transformed to reflect a single, common coding structure. To assist in standardizing business rules, new data elements are created so that business rules do not have to be coded into each program. This ensures consistent reporting and ease of maintenance, as there is only one source to update when changes are required.

Data can be accessed and presented in a number of different ways. An executive information system/decision support tool, HOLOS, is used to display standard charts and graphs over selectable periods of time. What-if calculations can also be performed with HOLOS. Microsoft Excel (or another SQL-compliant tool that is supported within the UIS architecture) may be used by the data analyst to extract data from the information warehouse for local data analysis and reporting.

The client/server architecture, along with specific software packages, are illustrated in Figure 2. Both Macintosh computers and IBM PC compatibles running Windows serve as client machines.

An innovative approach

Our implementation of PRO*C*AST has significantly differed from the way other institutions have implemented data warehouses. The project was undertaken as a systemwide effort to maximize the use of University resources, taking a low-budget, high-impact approach with minimal up-front investment. As success was demonstrated, we have added some additional resources. However, the initial investment was low and has continued to remain small.

Development of PRO*C*AST was not technology driven, though it easily could have been. The University did not take the approach of designing and populating an entire enterprise-wide database—an activity which would take a prohibitive amount of time, personnel, and machine resources before it was useful. Instead, the project focused first on understanding the pressing business problem and process ...

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Figure 1

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"The approach of populating the information warehouse as business needs are identified has proven highly effective for the user community ..."

provided by the University Controller’s Office using the same labor-intensive manual process needed to produce the annual financial report. This reporting is now accomplished through PRO*CAST.

• Human resource management reporting was transformed from a ten-page, difficult-to-digest, single-point-in-time report to several easy-to-read graphs that provide key information about staffing trends.

The approach of populating the information warehouse as business needs are identified has proven highly effective for the user community, and has not adversely affected the integrity of the database design or increased UIS maintenance efforts. For example, summary tables were created before the detailed tables to meet the business needs stated above and initially populated directly from legacy data sources. When detailed data tables were later added to the information warehouse, no redesign of the summary tables was needed.

The design approach also incorporated data administration modeling work where this was already available. Otherwise, the insights of the data administrator and application development groups were sought as a way to validate table design.

The PRO*CAST architecture includes provisions for distributed information warehouses that store campus-specific data of interest only to local, campus personnel. Planning is under way on some campuses to take advantage of this feature. For example, the Boston campus has initiated an Automated Management Reporting project with a key goal of enabling campus customers to take full advantage of data stored both locally and in the central information warehouse. PRO*CAST is currently delivering the core of this requirement—supplying data via the information warehouse, providing access through sophisticated reporting tools, and allowing data sharing through a wide area network with access to common file servers. The project team has identified opportunities for distributed data sources and is planning to avoid duplication by making the information systems complementary while still meeting local requirements. The next step is to develop a design for the data already stored locally.

Changes in operational procedures

In the past, data collection was cumbersome. Sometimes, several weeks of effort were required to collect the data to produce a single report. Each campus sent data by hard copy (often a computer printout) which was keyed by hand into a spreadsheet by the receiving department. Data from centralized legacy systems were obtained through antiquated batch report writing tools.
With PRO*CAST, the data collection process is more efficient. The method of obtaining data from the centralized legacy systems has been automated, and no human intervention is required to put the regular updates of information into the information warehouse. Data provided by the campuses now come in a machine-readable spreadsheet format, transmitted over the wide area network using work-group computing techniques. The spreadsheets are easily loaded into the information warehouse, saving countless hours of data entry time and making the data available for other uses beyond the original intent.

Reporting procedures have also been made more efficient. In the past, complex, linked spreadsheets were required to summarize data from the five campuses. Trend reporting required data from many point-in-time spreadsheet files. PRO*CAST eliminates the complicated reporting process by providing automatic summarization, drill-down capabilities for more detail, and drill-across for historical data.

**Other benefits**

Besides streamlining operational procedures, PRO*CAST has improved the quality and timeliness of information, has provided new capabilities such as access to new information or combinations of existing information previously unavailable, and has addressed data issues and specific technology goals of UIS. Many of these benefits are available not only to the University System but to each of the five campuses.

**Timely reporting and productivity**

- provides more timely information for review by management since information is available as soon as it is loaded
- improves data quality through direct feeds of data to the warehouse, eliminating errors produced by manual data entry, the cost of locating those errors (laborious quality control processes), and the consequences of making decisions based on erroneous information
- frees up many hours of staff time by replacing the manual data collection, allowing staff more time to add value to reports by providing interpretation or background information
- tailors the presentation of data to the needs of differing audiences, while also standardizing routine, periodic reporting

**New capabilities**

- provides new information, such as gift reporting, previously not collected in any form
- replaces the manual effort involved in gathering and graphing trend information
- makes it easier to compare the University to its peers by providing ready access to University statistics and incorporating national comparative data such as IPEDS
- provides online analytical processing capabilities, which result in new information and knowledge from existing data, including the ability to combine data from different operational areas such as finance, budget, human resources, and fund-raising

**Data issues**

- provides a single source of data, which eliminates the effort required to reconcile conflicting sets of data
- makes the reams of available data more usable by structuring the data and providing a cohesive set of tools for access and reporting
- raises management’s awareness of data issues, including data quality
- accounts for changes in data definition over time (e.g., in some years, tuition and fees were lumped together as a single revenue item; in other years, they were reported separately)

**Technology goals**

- provided a first step into “new” (client/server and relational database) technology for UIS
- provided the impetus for establishing workgroup computing so campuses could share data and work collaboratively
- encourages campuses in the system to deal with intra-campus and wide-area technology connectivity issues

Other, more general benefits have also been realized. For example, as University administrators began to use PRO*CAST, it raised their awareness of the value of management reporting, and of information technology in general. Its implementation spawned projects on several campuses to establish local, campus-specific information warehouses used in a distributed data model with PRO*CAST.

The project has also facilitated communica
The cost of the project, as mentioned earlier, was small—especially in relationship to the benefits. The costs came in two main areas, technology and personnel. Where possible, we also tried to build upon existing work and be creative in overcoming the obstacles that presented themselves.

**Building on existing work**

The ability to implement systems such as PRO*CAST requires teamwork from many areas in the information technology organization, as well as close partnerships with customers and their local information technology assistants. In UIS, this meant assistance from network services, desktop support, technical services, data administration, and application area specialists. It was useful and productive to build on the work already completed by these areas, such as data quality initiatives, key management reports and wide-area-network capabilities. For example, existing management reports were essential to establishing the executive information system (EIS) components. The human resources EIS used a widely accepted hardcopy management report as its framework. PRO*CAST added extensive trend reporting to the basic report framework, while ensuring that existing report information was readily available through point-and-click.

As newer tools, such as the EIS, became available, the developers found that there was increasing interest in direct access, rather than simply remaining in the point-and-click mode. This did not mean that the EIS component wasn’t required, but rather that customers felt that the EIS must be complemented by analytical access to the data used to derive EIS graphs and reports. This need has given UIS the opportunity to provide new tools in support of data analysis and to implement summary analytical data stores prior to EIS implementation.

**Support for meeting University goals**

Perhaps the most important benefit of PRO*CAST is that it is helping the University to achieve its strategic goals, in a number of ways. First, it allows University management to easily monitor progress towards those goals. Based on the measures set for the goals, management can determine where corrective action is necessary. For example, the Board of Trustees has identified a number of financial indicators to measure the financial health of the University, and they consider these indicators when formulating their strategy. PRO*CAST also allows management to model a variety of options, or analyze combinations of data not possible in the past, before planning a course of action or setting a policy. Finally, by producing measurable statistics, it increases the confidence level of external funding sources, such as the governor and legislature, by demonstrating that the University is making progress towards its redefined mission and is using its resources effectively.

**Investment in technology**

To minimize project costs, the University took advantage of technology resources that were already in place or under development: the wide area network, existing local area networks, VAX, Rdb (for the information warehouse), Excel (to provide reporting capabilities for the information warehouse), and SAS (for data extraction from the legacy systems). The only significant technology investment was purchase of an executive information/decision support software tool (HOLOS). A few small (~$500) purchases were made in order to assess client-based reporting tools.
Investment in personnel

UIS worked closely with our user community, particularly the University budget director, chief financial officer of the University Foundation, University controller, and University payroll coordinator, to identify important business problems and to understand where the data could be found and how the information should be stored and presented. Despite the close working relationship, the vast majority of project effort was expended by UIS staff.

University Information Systems reallocated staff positions for this project. The initial development team comprised 3.3 FTE including the manager, with vital assistance provided by network and desktop support personnel. In addition to development of PRO*CAST, this same group was responsible for the University-wide data administration function. As success has been demonstrated and as UIS has reorganized to meet new needs, additional staff and responsibilities have been added to expand the role of the group.

Obstacles

There were obstacles that had to be overcome in implementing PRO*CAST. The use of new technologies presented a significant challenge to the development team and the infrastructure partners. These staff had no prior experience on the VAX, Rdb, the middleware, Excel-Rdb connectivity—yet these technologies were the core of the initial implementation! Although there were limited training funds available, the development team accepted the challenge with a positive attitude and used innovative approaches to the training. The single most important factor in acquiring the technical knowledge was the team’s commitment to the success of the project. Everyone recognized that the business needs were critical, and that there simply was not sufficient time or money to engage in a lengthy traditional training approach.

The budget did support a one-day Rdb overview by DEC, and purchase of one programmed instruction course in VAX utilities. A UMASS graduate education major was recruited to present the programmed instruction modules in a classroom setting. This enabled the entire team to share the learning process and delivered training for a fraction of the cost of sending the team for outside training. This approach also enabled the team to focus the training on only the most relevant topics. Several other training items were provided in brief demonstrations by key staff such as the VAX systems administrator.

Bringing connectivity to the desktop and providing desktop installations of the necessary middleware were key to the success of the project. UIS enlisted the assistance of the technical support staff on each of the campuses to help provide the necessary connections and support for the project.

Vendor partnership

To expedite the project, UIS partnered with Digital Equipment Corporation for consulting assistance in loading and tuning the first two tables of the information warehouse relational
PRO*CAST assists in monitoring progress toward the University's goals

PRO*CAST currently provides some of the financial and financial-aid indicators used to measure progress toward University and campus goals. Work is under way to supply the remainder of this information. Discussions have begun concerning inclusion of academic and student-related data—the most complex of the subject areas.

Example: selected campus measurable goals for the "reaffirming teaching and learning" strategic priority

**Goal:** Increase access to and affordability of a UMass education.
**Measures:** rate of growth in tuition and fees; unmet financial need as a percent of total need; loans as a percent of total need; state share of unrestricted E&G expenditures

**Goal:** Provide high quality undergraduate instruction in a broad range of disciplines.
**Measures:** unrestricted E&G spending per FTE student; percentage of core faculty teaching undergraduates; percentage of undergraduate courses taught by core faculty

**Goal:** Promote student success in earning a baccalaureate degree and preparing for advanced study.
**Measures:** one-year retention rates for full-time freshmen; graduation rates for full-time freshmen; performance on specialized exams

As PRO*CAST grows to encompass data from multiple business operations, it is becoming increasingly easier to perform management analyses that require data from multiple activities. Comparisons to information reported in publications such as the Chronicle of Higher Education are improved in both timeliness and efficiency through facilities PRO*CAST provides. Information warehouse sources that conform to national standards further facilitate comparison. The University's gift-reporting data conform to the Council for Aid to Education standards, and plans are under way to offer additional comparative capabilities by deriving standard measures from existing data. This will include applying transformations to derive national classifications such as those used by the American Association of University Professors (AAUP).

**Conclusion**

PRO*CAST has served its purpose well and continues to be a key element in the President's Action Plan for the Year 2000. It is expanding to include new users, as networking capabilities are brought to more desktops. Additional business problems are also being defined as word spreads about the value of PRO*CAST. As we look to the future, our biggest challenges will be keeping up with the training demands for more ad hoc data manipulation from the desktop, responding to the increasing requests for new types of information, and bringing in external data for institutional benchmarks and comparisons.