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Portals are the first “killer” applications of knowledge management due to their versatility, broad technical and functional capabilities, and ease of use. Well-designed portals allow institutions to create and implement the knowledge management strategy of their choice. This chapter presents the elements, components, and processes involved in setting and maintaining portals. It uses Santa Barbara City College as a case study of a portal implementation with the purpose of supporting knowledge management, and it underscores the role played and benefits gained by institutional research and the college as a result.

Building Portals for Higher Education

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This chapter explores the underlying purposes and architecture for the use of portal technology as the keystone for knowledge management systems in higher education. The discussion of portal technology is exemplified by Santa Barbara City College's development of portal strategies and processes to support the college's Intranet.

There are many definitions of a portal. Gartner Group includes four basic components in its definition of a portal: connection, content, commerce, and community (Yanosky, 2000). Santa Barbara City College has developed the following working definition for its knowledge management project: “A portal is a personalized collection of information, content, and services.” Personalization is a key to a successful knowledge management implementation, as it provides access to targeted information based on individual roles and responsibilities within the institution. The collection of disparate content into a well-structured personal portal page is also an important element of success in the design and implementation of a portal. Finally, the portal must provide more than simple access to data. It must provide the search, navigation, analytical, and communication tools necessary for members of the institution's community to do their work in a collaborative manner.

Santa Barbara City College's Project Redesign and Portal Development

For the past six years, Santa Barbara City College has undertaken a systematic and wide-ranging assessment of institutional effectiveness and reengineering of college business practices in its Project Redesign initiative (Rudy, 1996). The college has approached the development of its college Intranet from the perspective of implementing many of the recommendations of the

redesign teams. Recent developments in portal technologies and tools have allowed the institution to design and develop Intranet applications to meet the objectives of Project Redesign and provide a framework for knowledge management within the institution.

The institution's key goals for its Intranet portal include the following:

- Improve access to college information
- Improve understanding and use of college information
- Improve institutional decision making
- Improve collaboration and communication among college departments

The college has identified a number of key components that must be in place within its knowledge management framework for the institution to achieve these goals. Of primary importance is the development of a decision support system to support and enhance the operational, evaluation, research, and planning functions within the institution. A second key area is document management. All college policies, procedures, reports, meeting agendas and minutes, and key college publications will be included within the knowledge management portal. Electronic forms and workflow capabilities are essential to support the improvement and automation of Santa Barbara City College business processes. More effective mechanisms for Web content development and administration are also important components of the knowledge management project. Expanded use of college e-mail alerts and notifications, as well as structures for increasing college communications, are objectives of the project. Finally, database security and management provide the technical infrastructure to implement a robust and secure knowledge management system.

The college Intranet portal project is a joint initiative of the information resources division and the office of institutional assessment, research, and planning. The development of decision support information is at the heart of this project. As such, the role of the office of institutional assessment, research, and planning is critical to the success of the portal project. The college cabinet and college planning council provide overall project leadership and direction. Key decisions must be made regarding information architecture, analytical tools, and access security. The information systems development team and the office of institutional assessment, research, and planning should make these decisions jointly. Lack of cooperation, planning, and skills development between these entities will place such projects at risk. Institutional researchers must become core members of the institution's Web development team during the design, development, and deployment of a campus Intranet portal.

What Is a Portal?

As we all know the Internet has become an integrated component of our work and personal lives. The number of Web hosts has grown from 1.3 million in 1993 to over a hundred million at the beginning of 2001 (Internet

Software Consortium, *Internet Domain Survey*, 2001). These hosts generate approximately one billion URLs (Universal Resource Locators). Gartner Group estimates that by 2003 more than 90 percent of government entities will deploy one or more portals to serve their constituencies (Di Maio, 2001). As discussed in Chapter One, we are being inundated with a growing amount of information, a situation that creates a strong need to find a method of organizing the information that is pertinent for our interests and responsibilities. Portals provide such organization. Ryland (2000) points out the importance of effective knowledge navigation, and “finds us at the very early stages of understanding how to manage and navigate through the huge volumes of information and knowledge being made available through the World Wide Web on the Internet.”

Web portals are one of the most popular topics of discussion in technology today. With so much written on portals one would assume that a common definition would be available. Frequently we find that these definitions do not synchronize with each other. Some people see this as a problem; we see this as an opportunity. In fact, that is the beauty of a portal, each person can have his or her own definition. A definition of a basic portal is rather simple: a gateway to network-accessible resources (Intranet, Extranet, and Internet). A simple Web page could fit this definition, as could a complex site composed of thousands of Web pages. Some of the early portals were quite simple, offering their visitors a static view of content from a small number of sources.

As our user communities have become aware of the Internet, their expectation of a usable and acceptable Web portal has risen. No longer are people satisfied to use a generic portal that is designed to meet the lowest common denominator of all of the target audiences. Today there is an increased need for personal portals. A personal portal is one that is personalized and potentially customizable for a particular individual. These portals should be dynamic, providing each individual user with their own view of the information resources that is current.

Commercial examples of portals include my.oracle.com, my.yahoo.com, excite.com, and many others. Individual organizations are increasingly building their own corporate portals for both Internet and Intranet use. This chapter provides information on how colleges and universities can build and benefit from these portals and more specifically how they can assist institutional research efforts.

Why Are Portals Useful?

There is one major reason for portals, efficiency. Portals help make more efficient use of an individual's time, one of the most important organizational resources. With the ever-increasing glut of data, it is essential to provide an organization's constituencies with focused information that can facilitate better decision making. Moore (2001) points out the importance of integration of applications, rather than a simple collection of content,

within the portal. A portal will never provide a person with all of their informational needs. An organization can create a gateway, however, that should provide a significant amount of core information. Again, personalization of portal content is an important element in making the campus Intranet useful to a broad set of constituents. Borck (2001) points out the emerging importance of “context personalization” for personalized portal applications, based on factors such as a user’s current task, time of day, accessing device, bandwidth, and location.

Importance to Institutional Research

A great deal of organizational information is stored, in various forms, in the data that are collected through the daily operations of a college or university. In some cases it is important to provide immediate access to the data in order to make short-term decisions, in other cases information is aggregated, verified, and summarized to provide a longer-term perspective. One of the challenges for offices of institutional research is the development of methods to deliver this information to those individuals and offices that can benefit most. Frequently this information is filed away or published in formats that are not conducive to frequent, broad, and immediate dissemination. A Web portal can increase the distribution of this information dramatically and can do so in a secure manner.

Using a personalized and focused design, information that previously was difficult to access can be published in a Business Intelligence Portal (BIP). Frequently, Web sites are designed to provide only a static view of information; an effective institutional portal can integrate dynamic query and display of data, thereby greatly increasing the utilization of critical knowledge for institutional decision making.

Portal Architecture

A Web site, or portal, consists of several hardware and software components that perform the functions of servicing the user’s requests and assembling the necessary information for delivery through a Web browser. Many of these components share the term *server*, whether they consist of computer software or hardware. The software components can reside either on separate hardware servers or be colocated on a single device. The hardware architecture decision is usually determined based upon the projected demands on the Web site. A well-designed Web site should be able to accommodate growth and provide for flexibility in hardware configuration as the needs of the organization change. Typically a Web site consists of the following software components:

- Web server
- File system or database
- Application server

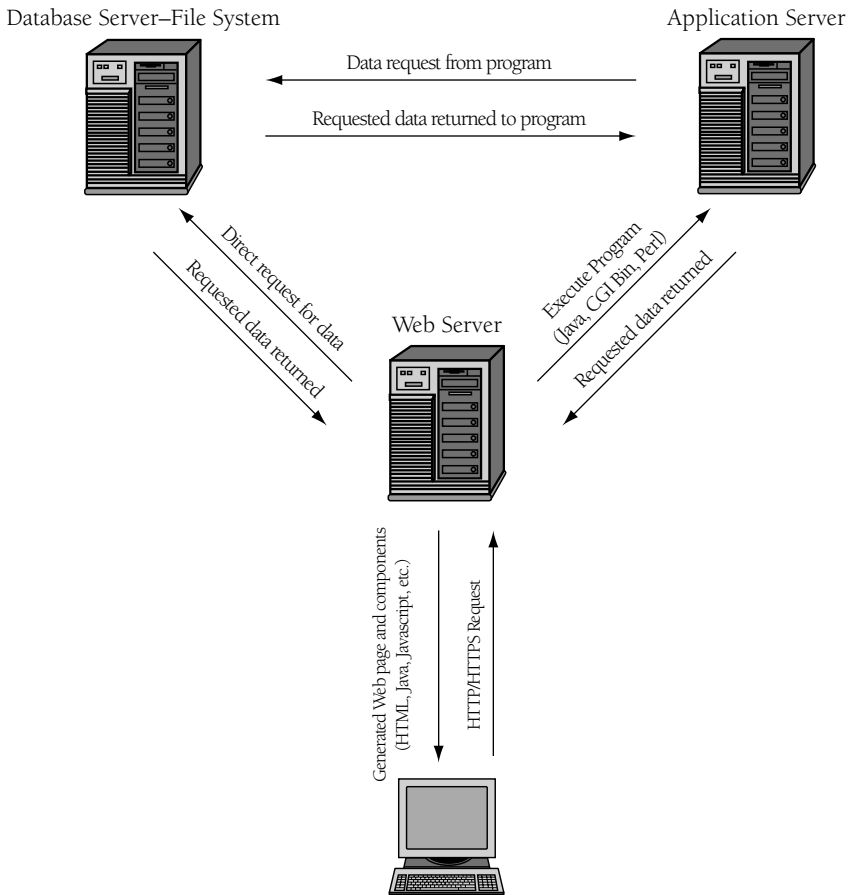
Figure 3.1. Portal Architecture

Figure 3.1 provides a high-level overview of the portal architecture.

The Web server provides the initial connection link between the user's Web browser (Netscape Communicator, Microsoft Internet Explorer) and the Web pages using the Hypertext Transfer Protocol (HTTP) or the secure version of HTTP—HTTPS. When the Web server receives the request for a page, it determines the appropriate service to provide that information. If the requested page contains static information, such as text or graphics, the information may simply be retrieved from the server's file system. In many cases, the information will reside in multiple locations, requiring the Web server to send additional requests to the remote content providers. After the information is collected, the Web server will send the completed information back to the requesting user.

Frequently Web pages contain additional functionality such as searching, calculations, and other actions. The application server (which can be an integral component of the Web server) provides these functions with the capability to execute these requests. The applications could be designed in Java, C, Perl, or a variety of other languages. The application server also can manage the authentication and authorization functions for those sites that require secure access.

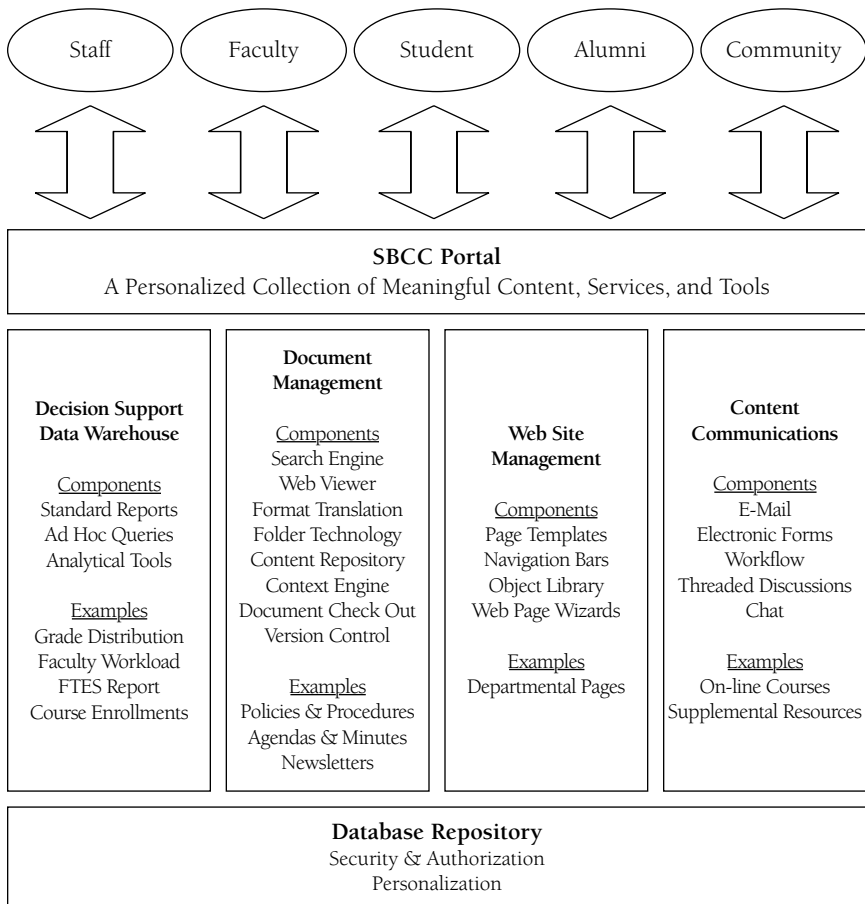
Web sites increasingly store only a limited portion of their information as static pages. The majority of portal Web pages are dynamic—the pages do not exist until a user requests them. These dynamic pages are composed of various components that may exist at different locations, both internal and external to an organization. The components are assembled based upon the specific request and then delivered via the Web server to the users.

In conjunction with a single user sign-on and interface, this architecture allows the personalization of content through the collection and presentation of multiple portal components: applications, services, tools, and data.

Santa Barbara City College Portal Functionality and Framework

The institution must have a well-defined portal architecture and toolset before successful planning and implementation can begin. Santa Barbara City College has identified four major components of our portal strategy: decision support and data warehousing, document management, Web site management, and content communications. Figure 3.2 provides an overview of Santa Barbara City College's portal components and architecture.

This section describes these components in detail and discusses the specific technologies that Santa Barbara City College is using to implement portal technology in relation to its knowledge management initiative. Key software tools within Santa Barbara City College's portal implementation include WebCT for courseware development and delivery, Campus Pipeline for student Web access, iPlanet for messaging and calendar services, Oracle Portal for Intranet development, and Oracle Database and Applications for electronic forms and workflow. The selection of specific vendor tools must be undertaken with an eye toward the integration of multiple tools into an overall campus architecture. For Santa Barbara City College, the recent integration of WebCT and Campus Pipeline into a single sign-on, session management, and course framework was a significant step forward in providing a user-friendly and intuitive framework for our students. In building their campus portals, institutions have used different vendors and tools successfully. Chapter Six provides additional information regarding some of the available options. Santa Barbara City College's selection of portal toolsets has been conditioned largely by the selection by faculty of the WebCT product for instructional courseware development and delivery and on the selection of Oracle Applications for campus administrative systems.

Figure 3.2. Santa Barbara City College Portal Framework

Decision Support

A key goal of any knowledge management implementation must be to structure information to assist in college decision making. While “executive information systems” have been components of many campus administrative information systems, the advent of portal technology offers several new capabilities. By far the most important of these is the ability to personalize the content of the decision support system based on user responsibilities and individual preferences.

At Santa Barbara City College, the initial focus of decision support activities has been to support academic program review, college planning and resource rankings, institutional effectiveness assessment, and accreditation. Roueche, Ely, and Roueche (2001) point out the importance of such

institutional assessment in describing the Community College of Denver's pursuit of excellence. Common measures of institutional effectiveness are used for many of these purposes. Measures of successful course completions, faculty load, and productivity are used on an institutional basis in its annual assessment of institutional effectiveness. The academic senate and college planning council use these same measures at the departmental level to make decisions concerning the ranking of new faculty positions. Division deans and department chairs use these same measures during the evaluation of individual faculty members.

Effective use of information to support these multiple purposes requires several capabilities. Access to data must be controlled by the role or responsibilities of individuals within the organization. Specifically, institutional policy decisions concerning access to departmental and individual faculty data must be supported by the database application. In addition, it must be easy for users to navigate through the various levels of organizational hierarchies through "drill down" and "roll up" capabilities. Flexibility also must be provided in the availability of analytical tools to support the personalization of the decision support system, as individuals use and analyze data in many different ways.

The decision support function of the institutional knowledge management system is a primary responsibility of the office of institutional assessment, research, and planning at Santa Barbara City College. This responsibility includes guiding the institutional discussions of appropriate measures to be used, designing data warehouse structures, developing standard reports and query templates, as well as training college faculty and management to use the tools and information effectively in support of their respective roles. It was a very deliberate decision by the college to place these functions within this office. There were several reasons for this decision. First, the college needed a central department to coordinate the design and development of the institution's decision support systems. The institutional research function has a collegewide perspective of information structures, reporting, and use. Second, the institutional research function has the technical expertise to use data management and analytical tools effectively. Finally, and perhaps most important, the office is charged with defining the implications for college practice from all research studies and data analyses conducted on campus. Research and analysis are of very limited use to the institution unless they are constantly applied to determine how the institution can improve the quality and responsiveness of its operations and services.

At Santa Barbara City College, this pivotal role is assigned to the office of institutional assessment, research, and planning. This responsibility places very broad demands on this office: database design, data analysis, policy development, and technology planning and implementation. Some offices of institutional research may be reluctant to undertake these broadened areas of responsibilities. This expanded role for the institutional

research function is, however, a natural outcome of increased institutional focus on data driven decision making and accountability. These added responsibilities also place additional demands on the ability of the institutional research office to recruit, train, and retain staff conversant in research methodologies, analytical tools, Web development, databases, and higher education policy.

Document Management

College policies, procedures, and operational processes must be stored and retrieved easily. This requirement poses many organizational and technical challenges for the designers of institutional knowledge management systems. Support for document management is an essential component of knowledge management.

The use of structured, hierarchical document storage taxonomies versus “unstructured” search capabilities is a key design decision for institutions. Santa Barbara City College chose to emphasize the latter approach due to reduced maintenance costs and increased flexibility for information access. For this approach to be successful, however, the search engine must be able to conduct full-text searches of archived documents, rather than relying on key words, abstracts, or titles. While these capabilities are now part of all desktop operating systems, the extension to all campus policies, procedures, and official documents requires a very robust and efficient search mechanism to deal with the hundreds of institutional documents contained on the college Intranet (or in the college Intranet environment).

Establishing standards for document storage and viewing formats also presents challenges for institutions. Santa Barbara City College made the decision to provide browser-based access to all documents contained in the knowledge management database or “repository.” Early on, this meant conversion of documents to HTML and centralized posting of documents by our Web development department. With the implementation of the Oracle Portal product technology, the process for storage and retrieval of documents has been much improved. Files are stored in the database in their native formats (Word, Excel, PDF [portable document format], HTML [hypertext mark-up language], and so forth) but are viewed through a Web browser without required plug-ins due to “on the fly” translation of these file formats to HTML. This capability saves much time in file creation and maintenance within the college Intranet system. These stored documents also can be accessed directly by users from the database in their native formats.

Understanding the context of key word search results is another design component of document management. This component includes having an efficient weighting system for prioritizing search results. Along with the weighting algorithm, the Oracle Portal, using the integrated Oracle Text capability, develops *themes* and *gists* for each document stored in the document management repository. The thematic analysis is based upon an

extensible thesaurus. The listing of themes outlines the central concepts presented in each document so that one can navigate quickly to the desired area. Gists present summary statements in narrative form of the key themes within each document. These capabilities assist users in understanding the context and content of documents contained within the knowledge management database, and are made possible through the use of a linguistics engine that is part of the Oracle Portal environment. Document versioning, end-dating, archiving, access control, and security are also important elements of document management capabilities that are a product of using a database for storage of documents within a knowledge management system.

These document management capabilities allow for rapid and efficient navigation of the institution's policies, procedures, and publications. A student or faculty member with questions concerning campus policies on grading can simply enter "grading" into the search engine and rapidly retrieve all Intranet documents containing the term. The individual can then navigate quickly internally within the documents to find specific highlighted references to grading. Themes from these documents, such as academic probation or grade point average, are also referenced to provide users with more refined choices for viewing. Campus directory information is another good example of the deployment to this technology. An on-line directory provides up-to-the-minute listings of college personnel and directory information that can be accessed easily by first name, last name, building, department, or other directory attributes.

Prior to the development of the college Intranet, these document management features were nonexistent at Santa Barbara City College. The function of storage and retention of documents was highly decentralized, with many differing departmental policies, tools, and practices. College standardization of these elements within the Intranet project has led to a far more comprehensive, useful, and powerful repository of campus electronic documents. This framework is an ideal way for offices of institutional research to make their publications available to their campus community. Adding research reports and publications to the document repository is easy to do. Once in the repository, for example, a study on the effectiveness of on-line instruction will be returned in the search results on queries for grading, retention, technology, and many other terms. This leads to greater dissemination and use of institutional research reports.

Web Content Development and Management

Web site content creation and management present a specialized case of document management functionality. Decentralization of Web content development and posting was a key objective for Santa Barbara City College's knowledge management Intranet application. The college had experienced great difficulty in training and support in HTML and FTP (file transfer protocol) for departmental Web developers. In addition, the

enforcement of design and navigation standards within departmental development proved problematic. These problems required that all Web content be routed to the Web development group to provide quality assurance and final posting to the college Web site. This process simply was not sustainable for the development and maintenance of the college's knowledge management Web site. The Oracle Portal technology provides end-user tools for the construction and maintenance of Web pages through a Web browser interface. Since these elements are stored directly into the portal database, there is no need for separate file transfer processes. The use of any such tool necessarily constrains page structure and functionality to some extent. For Santa Barbara City College, however, the significant gains in departmental Web development productivity have been well worth such constraints.

Dynamic Web page deployment is a key to the personalization of knowledge management systems. This requires that the individual's view of a Web page be built "on the fly" according to specific user roles, preferences, and access to information. Harris and Caldwell (2000) point out the need for "compelling technology" to support effective knowledge management systems. This move away from static, uniform HTML pages places significantly increased reliance and importance on the database capabilities of the institution. Individual user responsibilities, security, and preferences must be maintained in data structures that can support the rapid collection, assembly, and deployment of individual Web pages. This component-based approach to Web site construction allows for the re-use of templates, graphics, documents, and applications throughout the Web site.

Decentralization of Santa Barbara City College Web site content development and management is a major objective for our Intranet portal project. Our previous model for Web site maintenance had departmental Web page developers preparing content and then transferring that content to a holding area for review and posting by the college's Web development team (consisting of one Web master and one Web developer). This centralized approach provided quality assurance and standards review of pages before posting, but at great cost in terms of productivity of our Web development staff. In the new model, departmental content developers are given the ability to construct pages based on approved templates and using a central library of Web objects. Review of a Web page before posting has shifted from the Web development group to the departmental manager, who focuses on the accuracy and completeness of the page content. This direction is intended to provide more time for limited Web development resources to work on more technical issues, such as systems integration and security.

These Web content capabilities allow the office of institutional assessment, research, and planning to design, develop, and maintain a Web-based content area for research studies, reports, ad hoc queries, and analytical tools. The look and feel of the institutional research site can be customized within the institution's standard departmental page templates and tools. The

use of development “wizards” allows institutional researchers to develop Web-based delivery without requiring them to become experts in HTML, XML, or Java. This self-sufficiency for the offices of institutional research is a real benefit to those departments constantly trying to battle for information resource support with other college operating units. Again, the institutional research office must be viewed as an integral part of the college’s Web development team if campus objectives on improved decision making are to be realized.

Content Communications

Knowledge Management systems present opportunities for the automation of college forms and workflow to restructure institutional business processes. While most institutions have deployed Web technology to present electronic forms to the college community, far fewer have undertaken a systematic and rigorous management of their business processes with automated workflow engines. There are several reasons for this relatively slow adoption of workflow technology. First, institutions must invest the time and resources to document existing business processes in a consistent structure and methodology. This is a time-consuming and labor-intensive process. Santa Barbara City College spent three years using more than thirty project teams to document key business processes targeted for redesign through business process reengineering. The college experienced great difficulty in freeing key staff members to participate in these redesign sessions. A second roadblock to workflow automation has been the relative immaturity of the technology itself. Workflow tools have begun to deepen in product capabilities and simplify in terms of ease of use. Investment in workflow technology at the current time, however, means training of technology staff in the sometimes arcane use of workflow tools. The industry is still a long way away from providing simple end-user tools for automating and managing college workflow processes. A final reason for the slow adoption of workflow technology is the continuing maintenance and support needed to keep these systems current with changes in institutional process over time. Once the systems have been developed via workflow technology, revisions to college processes must be re-implemented by using the workflow engine.

Given these limitations, why would higher education institutions adopt processing strategies of electronic forms and automated workflow? The reasons are many. Most important, these technologies allow for the potential for saving much time and effort in the conduct of institutional business processes. Forms implemented in knowledge management systems can be routed simultaneously to multiple individuals for review and approval. In addition, college business rules for edit checks and calculations and institutional rules for routing and approval of documents can be enforced systematically without relying on the knowledge of the initiator on how to process the document. Capturing and storing process workflows and business rules also insulate the institution from the loss of key personnel who

maintain the knowledge of proper procedures in their heads. As discussed in Chapter One, far too often we bemoan the loss of key college staff and the institutional knowledge and history they take with them. The discipline and rigor associated with mapping institutional business processes and workflows also provide a wonderful opportunity for reexamining current business practices and procedures.

The implementation of portal technology is key to the successful implementation of a streamlined workflow process. Hayward (2000) notes the importance of conceiving of knowledge management as “not the implementation of a technology; rather, it is a multidiscipline approach that integrates business strategy, cultural values, and work processes.” The individual’s portal page becomes the central point of collection of tasks and activities from many different systems. A faculty member, for example, can receive class lists and rosters, initiate student drops, submit grades, initiate requisitions, conduct campus library searches, and analyze departmental performance data all from the same portal framework. Although the systems integration work of a portal implementation is a major undertaking, the rewards are substantial for end users in terms of ease of use.

Collaboration tools such as e-mail, discussion groups, chat, Web conferencing, workflow, alerts, and document sharing are essential components of the portal framework. These tools provide synchronous and asynchronous methods of communication and resource sharing among individuals and various constituencies of the college community. Integration of these various tools within the portal framework can be very challenging from a technical perspective, but is essential to realizing the time and resource saving potential of the institutional portal.

Identification of Communities

A first step in the definition of a campus portal is the identification of communities of interest to be served by the portal. What are the groups on campus that need to communicate and to have access to similar kinds of information? Once these communities are defined, the institution can begin planning the specific set of documents, information, forms, and services to be made available to each group. At Santa Barbara City College we have used the college Web committee to define these communities of interest, and then have used the college cabinet for the review and approval of these portal communities and services.

Toolset Evaluation

As discussed in Chapter Six, there are many portal providers and toolsets available to institutions of higher education, and many different approaches can be taken. Individual decisions by institutions are conditioned by many factors, including the following: current technology environment, technical expertise available at the institution, level of staffing for development

and support, and project funding to name a few. At Santa Barbara City College, for example, our choice of Campus Pipeline as a student portal framework was influenced significantly by its partnership with WebCT to integrate the instructional content development and delivery mechanisms of WebCT into the portal framework of Campus Pipeline under a single sign-on and authentication process. As we had committed previously to WebCT as our institutional toolset for instructional content management, portal vendor integration with WebCT loomed large in our decision process. Likewise, our selection of Oracle's Portal product for college Intranet development was influenced by our preexisting campus licensing agreement for Oracle database and applications development products (Portal is an integral component of Oracle's Internet Application Server product) and our use of Oracle applications for the college's administrative systems.

Regardless of the unique institutional circumstances, there are some important considerations that are common across institutions in terms of portal toolset selection. The Gartner Group has identified five criteria for institutional evaluation of portal framework products: robust search across all structured and unstructured repositories, taxonomy support, content management and aggregation, personalization, and application integration and development (Phifer and Zastrocky, 2000).

Data Warehouse Design

The development of an effective decision support system for the college is a primary objective of Santa Barbara City College's portal project. Previous institutional efforts in this area have not been successful due to several factors. First, development and maintenance resources have been limited to grant funding and were not sustainable by ongoing staff due to other systems development and maintenance tasks. Second, the use and navigation of client-based analytical tools were viewed as too cumbersome by campus managers. Third, and perhaps most important, managers lacked the time necessary to do detailed analysis of data provided in the data warehouse. These "lessons learned" by Santa Barbara City College in previous projects helped provide design objectives for the decision support functionality within the campus Intranet portal project.

Key measures need to be identified for each person or role using the portal. These measures will facilitate the personalization of the portal. The elements and level of detail that are needed by the president are significantly different from those of the vice presidents, deans, and department chairs. We need to create a customized "executive dashboard" for each of these roles within the institution. This dashboard needs to reflect information that is current and relevant to the decisions being made in each role. During registration, for example, department chairs and deans are monitoring course enrollments in order to make decisions on adding or canceling course sections. Both of these roles need to be able to view enrollment data—department

chairs for their specific department and deans for all departments within their area. Easy access to this structured set of data is important for timely and effective decision making during registration. While many other individuals within the institution are interested in such course enrollment data and should be able to query such information, it would not appear on their dashboard for action. Individual faculty members, for example, may want to save a query of course enrollments in their classes as an object on their portal page. Such personalized extension of the portal page is an important element of the success and usefulness of the portal application.

As noted previously, the focus of Santa Barbara City College's data warehousing strategy is to support institutional assessment, planning, resource allocation, and departmental program review activities. By design, there are many common measures that are used across these areas. Student course completion rates, grade distributions, faculty workload and productivity, full-time equivalent students, and full-time to part-time faculty ratios are examples of measures that serve many planning and evaluation purposes. Careful attention must be paid to the levels of aggregation, related variables, and security of these data in the data warehouse design. At Santa Barbara City College, the director of institutional assessment, research, and planning has the responsibility for the design and development of the data warehouse model, with assistance as needed from the information resources division in terms of data development and transformation. The college cabinet members work directly with the office of institutional assessment, research, and planning in defining the key measures of effectiveness to be used in their areas of responsibility.

Security Design

Access to specific pages, content, data elements, and levels of detail ideally is controlled by security measures within the portal database of users, responsibilities, and items. An individual user may have multiple responsibilities. Design considerations must be made to determine whether all elements of the multiple responsibilities will be displayed on the individual portal page, distributed to multiple pages based on responsibilities, or controlled by forcing a single responsibility to be selected at any one time. Another key element of portal security is the development of a single sign-on and authentication mechanism. Much of the ease of use within a portal framework disappears if users are required to log in to multiple applications within the portal. Security planning also must consider what access will be provided to users exclusively within the campus Intranet environment and what elements will be made available to portal users through Internet access. Although the goal for Santa Barbara City College is clearly "anytime, anywhere" access to campus information, product licensing and campus network security may often dictate limitation to access only while on campus.

Availability and Support

Another key planning dimension is to assess the need for ongoing support and sustainability of the portal environment. This operational planning has several components. First, support and maintenance of portal hardware and software must be considered. Any components of the portal framework that are made available over the Internet must be supported on a “7 by 24 by 365” basis. There is no excused downtime, no set hours of operation, and no patience for system failures. At Santa Barbara City College, this lesson was learned quickly as we developed our Online College offerings. In the first year of operation of the Online College, with a very limited number of courses offered, the “off-hour” demands on our Web master and user support staff were tremendous. During the second year of operation, the Online College contracted with a local Internet service provider for hardware, operating system, and help-desk support for the seventy courses offered. In the third year of operation, we contracted with Sprint Corporation’s Web Hosting Services to add the Campus Pipeline student portal server to the WebCT server hosting the Online College course content for more than a hundred courses. This year the college is adding an iPlanet messaging and calendaring server to the student portal, and also adding firewall security at the hosted site to serve in conjunction with the existing campus firewall. This portal framework will serve more than 130 course offerings and five thousand students. Whereas Sprint is providing around-the-clock support for the hardware, operating system, and network connectivity, the database and application level support are still the responsibility of, and managed by, the college.

Training

No portal implementation can achieve success without proper training of the college community on the structure, navigation, tools, content, and uses of the Intranet site. At Santa Barbara City College this training component includes presentations by the office of institutional assessment, research, and planning, the faculty resource center, the staff resource center, and the information resources division. The role of the office of institutional assessment, research, and planning is essential, in that it provides campus training on data structures, ad hoc query capabilities, analytical tools, and reporting. We have found that the most successful training is tied directly to the job requirements of the individual or group to be trained. Generic vendor training on a particular analysis tool, for example, is rarely sustainable when individuals return to their desks, because there is no structure for the immediate use and reinforcement of the training in a real-life situation. Our training modules have had far more success when designed around a departmental-specific analysis or task to be accomplished.

Project Staffing

The design, development, and implementation of a campus Intranet portal are significant undertakings for any institution. Both the time and resources that need to be committed to the project are precious commodities within higher education institutions. The challenges are particularly acute for community colleges and smaller four-year institutions that often lack the technology infrastructure and support mechanisms required for large-scale technology deployments. As in most human endeavors, however, good people working together in a focused way can accomplish much. At Santa Barbara City College the Intranet development team consisted of the following roles: project manager (one), institutional researcher (one), Web developer (one), database administrator (one), functional specialists (six), and trainers (two). This core development team worked to develop the initial prototype of the college Intranet portal presented to the college cabinet and management team. The group then began to fill in content for the production version of the portal. We brought in additional Web content developers from departmental staff as each new area was added to the production version of the portal. Just-in-time training was provided to the content developers in order for them to be ready to maintain content on an ongoing basis. The office of institutional assessment, research, and planning provided training to academic deans in decision-support tools and data. The working group developed the initial prototype in a month, whereas the additional specification of the production portal was a three-month project. We are now in a year-long project to complete the campus Intranet portal content and to move the service into ongoing maintenance and support.

Campus Portal Planning and Implementation

When beginning the implementation of a portal one of the most important considerations is to understand that the institution must have a long-term commitment to the project. A portal, by its dynamic nature, is never finished. As technology and the needs of the organization and individuals change, the portal must “morph” to meet the new demands. A portal that does not have this flexibility (and dedication to ongoing support and maintenance) is doomed. Like any major technology project, a significant institutional investment in planning and design of the institution’s portal is an important first step toward a successful implementation.

Conclusion

There are a few points from the chapter that deserve to be reinforced in conclusion. First, the development of systems, content, and processes for *personalized content delivery* is essential for a successful implementation of an

institutional portal. This objective should drive decisions concerning design, content, format, and tools to be used within the portal framework. The portal must be relevant and rewarding to individuals in their respective roles within the organization. Second, *decentralization of Web content* development and maintenance is a key objective for ongoing sustainability and support of an institutional portal. This is especially important for community colleges and smaller four-year institutions, and can be achieved through the development and training of departmental staff on institutional templates and resource libraries, stored in a central database repository. A formal training program for departmental Web developers is also a key success factor in this area. Third, the use of robust search engines provides a far more effective vehicle for document retrieval and management than relying on the navigation of hierarchical file folders or organizational taxonomies. *Rapid full-text search and weighting of all documents* (regardless of type) provide the most sustainable, flexible, and useful retrieval capabilities.

Finally, in a publication targeted to institutional researchers, a chapter written by institutional chief technology officers may be suspect. We would like to reiterate, however, our vision of the *central role played by institutional research* within the development of higher education portals. At Santa Barbara City College, the office of institutional assessment, research, and planning is driving the design and development of the institutional portal to implement a new decision-support system. We have pointed out the significantly expanded role this has meant for the institutional research function within the college in terms of database design, policy development, Web content development, training, and technology infrastructure planning. This expansion of responsibilities may be viewed skeptically by some in the profession but is a rather natural outcome of placing improved institutional decision making at the heart of higher education Intranet portal strategies.

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