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TEACHING WITH ENTERPRISE SYSTEMS

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ABSTRACT

With the wide-spread adoption of Enterprise Systems (ES), such as SAP, Oracle, and Peoplesoft, in medium and large-sized organizations, there is increasing demand for students who know how to work with such systems. While the demand for ES developers and integrators has declined, the demand for employees that can help companies achieve benefits from these systems continues to grow. Such employees need skills in decision-making and process design in an integrated, data-rich environment enabled by an ES. This paper provides advice about teaching with enterprise systems at the undergraduate and graduate levels within the IS curriculum and across management and engineering curricula. This advice is provided by five professors from five different schools, California State University at Chico, Louisiana State University, Queensland University of Technology, Bentley College, and Worcester Polytechnic Institute that together have many years of experience in teaching with SAP or with the Oracle e-business suite. This paper includes a summary of the experiences at each of these schools, advice based on questions from the audience at an AMCIS 2005 panel, and references to resources that may be helpful to those considering, or already engaged in, teaching with enterprise systems.

I. WHY TEACH WITH ENTERPRISE SYSTEMS

Enterprise Systems (ES) have become a critical backbone for most companies' business processes. An ES package includes the internal back office functions, e.g., financials, order and production management, and human resources, which collectively comprised Enterprise

Resource Planning (ERP) systems, as well as newer extended enterprise modules, such as supply chain management (SCM) and customer relationship management (CRM). Companies using such systems depend upon employees with ES experience to help them install, extend, and achieve benefits from these systems. Despite the critical need of companies for ES-savvy workers, students still rarely encounter an ES during their university education. The challenges universities face in integrating an ES into a curriculum and in achieving educational benefits from such implementations differ from those of business organizations, but are no less difficult.

This paper started as a panel at the 2005 Americas Conference on Information Systems in Omaha, NE [Strong, Corbitt, Fedorowicz, Stewart, and Watson, 2005]. A starting point for the panel was a special issue of the *Journal of Information Systems Education* [Antonucci, Corbitt, Stewart, and Harris, 2004]. The goal of the panel was to contribute to the ability of more universities to provide a stimulating ES-based educational environment for students. The panel presented the experiences of those who had integrated Enterprise Systems into their curricula and provided advice to the audience about teaching with enterprise systems at their schools. This paper represents a report of the panel and a list of additional references and resources.

The five panelists represent five different schools – California State University at Chico (CSUC), Louisiana State University (LSU), Queensland University of Technology (QUT), Bentley College (Bentley), and Worcester Polytechnic Institute (WPI) – and five different approaches to integrating enterprise systems into a curriculum. The first four schools listed use mySAP ERP and mySAP Business Suite, while WPI uses the Oracle e-business suite. In 1996 CSUC was the first university in the U.S. to receive the SAP R/3 System for use in the classroom. The SAP University Alliance (UA) program in the U.S., leveraging the experiences of the successful program in Germany, was started during the 1996/1997 academic year. In 1997, LSU became a member of the U.S. program, while QUT joined the Australian program. Bentley joined the SAP UA in 1998. WPI joined the Oracle Academic Initiative in 2000.

The first purpose of this paper is to present the approaches taken by each of these five schools to illustrate the various options available for integrating enterprise systems into a curriculum. For each school, the paper describes when and why it started with enterprise systems, its initial focus and purpose with any major transitions or changes in focus over the years, the courses with hands-on ES content, what it plans for the future, and major lessons learned. The second purpose of this paper is to provide assistance to schools who are involved in, or are thinking about initiating, the use of enterprise systems in their curricula. The paper presents some of the questions asked by the audience at the AMCIS panel and provides a list of resources in the bibliography.

II. FIVE SCHOOLS AND FIVE APPROACHES

The panelists used a common format to present their experiences with teaching with enterprise systems and then expanded on each item. A summary is provided in Table 1, followed by a more detailed description for each school.

CALIFORNIA STATE UNIVERSITY AT CHICO

Motivation and Focus

In June of 1996, SAP America selected the California State University Chico (CSUC) College of Business as its first North American partner in the company's University Alliance Program. Prior to joining the UA, a group of business faculty at CSUC had been working to identify an ERP system that could provide adequate support for curriculum integration efforts. Choosing SAP, the world leader in enterprise software for businesses, and becoming a SAP UA partner was seen as a unique opportunity to provide students with a deeper understanding of how businesses actually operate. In addition, UA membership supported the University's mission to build a state-of-the-art technological learning environment to provide students with high-demand knowledge and skills, and prepare them for success in the new information economy. Providing SAP R/3 access to all

disciplines was expected to pay dividends as faculty members worked together to develop integrated approaches to coursework in the functional areas and as students observed the cross-functional nature of today's business processes as embodied in modern enterprise software systems.

Table 1. Current Enterprise System Features at each School

	CSUC	LSU	QUT	Bentley	WPI
Year Joined	1996	1997	1997	1998	2000
Grad or UG	Mostly UG	Both	Both	Both	Mostly UG
Developer* or User	Both	Both	Both	User	User
Disciplines involved	Accounting, MIS, SCM, HR, Finance, Marketing	IS, POM, Accounting, Marketing	AIS, HR, OB, Engineering, IT	Accounting, AIS, Finance, MBA	Accounting, Operations & Industrial Engineering, MIS
Number of ES-related courses	21	8	16	10-15	4-6
Number of Faculty involved	15	5	9	10-15	3-5
Software	SAP	SAP	SAP	SAP	Oracle
Host for SW	CSUC UCC	LSU UCC	QUT UCC	Drexel UCC	WPI hosts

*The term developer includes the role of systems integrator, often performed by consultants

Funding the ES Initiative

The SAP initiative at CSUC was originally funded through grants of cash, hardware, software, consultation services, and faculty internships. These resources were provided in large part by a group of industry partners including Hewlett Packard, IBM, Bristol Myers Squibb, ChevronTexaco, Applied Materials, Foundation Health and SAP. By the end of 1998, approximately $300,000 (not including a $430,000 equipment grant from Hewlett Packard) had been invested in the infrastructure needed to launch the program. For the next two years, an annual operating budget of $290,000 was required to support ongoing activities such as curriculum development, system administration, hardware/software maintenance, and faculty training.

Courses and Faculty

The emphasis on integrating ES into the curriculum is aimed primarily at the undergraduate program. Although the CSUC College of Business offers graduate study leading to an MBA degree, the MBA program represents only a small proportion (5%) of total enrollment. Presently

there are 15 faculty members (27%) who teach courses containing an SAP element. As listed in Table 2, there are currently 21 course offerings at CSUC that incorporate an ES component.

Table 2. ES-enabled Courses at CSUC

Accounting	Supply Chain Management	Management Information Systems	Finance, Marketing, or Management
Cost Accounting	Cost Accounting for Production	Business Technology Integration (Introduction to MIS)	Financial Management
Accounting Information Systems and Control	Purchasing and Supply Chain Management	Business Systems Analysis	E-Marketing
Intermediate Accounting	Quality Management	ERP Configuration and Use	Human Resources Strategy and Information Systems
SAP Accounting Applications	Production Planning and Inventory Control	ERP Systems Administration	
Planning, Control and Performance Evaluation Using ERP	Production Planning and Control Systems	Enterprise Application Architecture (ABAP/Java Programming)	
Information Technology Auditing	Information Systems for Operations	Strategic Information Systems Management	

The most recent addition to the CSUC SAP portfolio was the Information Technology Auditing course. The Enterprise Application Architecture course is currently being revamped and there is talk of offering a special topics course covering Business Use of Geographical Information Systems (GIS) which would make use of the GIS extensions available in SAP.

Integrating the Curriculum

The courses listed in the first three columns of Table 2 are offered by one department, the Accounting and Management Information Systems (AMIS) Department, which includes the Accounting, MIS, and Supply Chain Management faculty. Thus, substantial integration of the curriculum across functions is provided in this single department.

Reflection on the CSUC Program

In comparison to other UA institutions, the CSUC College of Business offers a relatively large number of ES-related courses. The current number, 21, has grown over the past eight years from an initial offering of only two "special topics" courses. Even though SAP use has been injected into a number of existing courses, the general strategy for growing the SAP portfolio has been for one faculty member (or sometimes a pair) to develop a course idea and initially offer it as a special topics course. If there is sufficient demand generated for the new course, it will ultimately be added to the official college catalog. The recipe for success at CSUC has been a bootstrapping approach, i.e., starting small and building upon prior achievements.

Despite this apparent success, only three faculty members outside the AMIS department are teaching with ES (one each in Finance, Marketing, and Management). One reason is pedagogical; i.e., a reluctance to emphasize skills training in lieu of more orthodox academic elements such as frameworks, analogies, conceptual models, and theories. A second reason is practical; the "publish or perish" reward system of higher education encourages faculty members (especially non-tenured faculty members) to emphasize research and publication over performance in the classroom. When the promotion and tenure process fails to acknowledge the significant investment in time and effort required to become a member of the ES "team", there is no particular incentive for faculty members to do so. Under such circumstances, success of an ES initiative relies heavily on the degree of altruism found among the faculty. Given an environment of tight budget constraints that characterize higher education in general, and the California State University system in particular, CSUC has been both skillful and fortunate in recruiting, training, and retaining an ES-friendly faculty.

From the perspective of students, two studies undertaken by members of the CSUC faculty clearly indicate that students who pursue ES-intensive coursework command higher starting salaries than those who do not [Corbitt and Mensching, 2000; Borquez, et al., 2005]. For these SAP-trained graduates who are recruited by companies such as BearingPoint, Hewlett Packard, Chevron, and Micron Technology and enjoy, on average, a salary differential of $5,500 USD per year, the SAP initiative has undoubtedly been a success. Moreover, feedback from industry partners, the CSUC faculty, and former students indicates that our graduates are indeed developing a profound appreciation for the way business is conducted in process-centric, networked organizations.

LOUISIANA STATE UNIVERSITY

Motivation and Focus

When LSU joined the SAP UA program in 1997, the ERP market was on fire and a race began among schools to determine who would make the most of their program, and who would attract top recruiters. The author from LSU remembers a small group of IBM Global Services consulting managers literally got down on their knees, clasped their hands and yelled, "We want your students" at an SAP SAPPHIRE conference after hearing about the student's exposure and experience with the SAP R/3 system in the classroom. The motivation to join the SAP UA program was rooted in the desire to make an outdated curriculum more relevant. LSU wanted to provide students with hands-on experience with a real system, to reinforce the textbook theory and principles with real-world practice, and to provide students with an experiential learning environment, cutting edge technology, and team-based activities. Although LSU originally wanted to utilize the ES for cross-functional education, it later realized that the technology itself could not alleviate the organizational challenges of moving a College to cross-functional curriculum, and this objective was dropped. In the end, a grass roots approach, within the department of Information Systems and Decision Sciences (ISDS) was taken. For a discussion of LSU's early experiences with the SAP program and related curriculum efforts, see Watson and Schneider [1999].

Funding the ES Initiative

At this early stage, many schools were willing and able (sometimes through corporate donations) to pay a full-time SAP Basis administrator, a $5,000 membership fee, $30,000 to $100,000 for a computer server(s), and travel costs to send faculty to training. At LSU, the Dean recognized the value of the SAP program and sponsored a full-time SAP systems administrator. One faculty grant paid for a server and another faculty grant paid for travel expenses for training. The ISDS department paid for the membership fee, although this cost was eventually recovered from corporate donations. One faculty member, with support of the Department Chair, MBA Director, and Dean, spearheaded this effort.

Courses and Faculty

Currently, five faculty members at LSU actively participate, four from ISDS and one from Accounting, although almost two dozen faculty members have been involved over the past eight years. These others have moved, graduated (PhD students), or retired. A few who attended training decided the software was not a good fit for their particular curriculum. The four courses listed in Table 3 are currently offered in both undergraduate and graduate versions.

Enterprise Systems I is an excellent example of a typical ES course at LSU. In the 1990s, this course emphasized business process reengineering and process innovation, using books such as Davenport [1993, 2000] and Hammer [1993, 1996], as well as Harvard Business School Publishing cases and articles. SAP training was the source of hands-on exercises. Students were exposed to core business processes, business process design and management, application development tools, and systems administration tools.

Table 3. ES-enabled Courses at LSU for MBA, MS IS, and BS IS Programs

Course	Brief Description
Enterprise Systems I: Business process integration and management	Business Process Overview, Business Process Integration and ERP configuration, Effective Use
Enterprise Systems II: Strategic enterprise systems applications	Strategic enterprise applications and e-Business. Review of enterprise applications such as customer relationship management, supply chain management, strategic enterprise management, and portals. Corporate governance and audit issues associated with enterprise systems.
Process Planning and Control	Integration of production operations with other areas of the business. ERP support of production functions, supply chain optimization in enterprise systems
Business Intelligence	Theory and practice of data warehousing to support business intelligence.

Today, ES I consists of three parts. The first, business process overview, covers the basic business processes of a hypothetical company (Fitter Snacker) that produces health bars. This segment uses the Monk and Wagner [2006] text, which emphasizes differences between

business processes with and without integrated systems. Students learn business terminology, business processes, and best practices. Using hands-on exercises [Wagner, 2005a], students simulate these business processes (e.g., sales order management, supply chain management, accounting and finance, and human resources) with a "real" SAP system. It is not until students actually execute ES transactions that they realize the challenges of interfacing with an ES.

The second segment, business process integration, focuses on the process of designing, specifying, and configuring business processes. Additional hands-on exercises [Wagner, 2005b] walk students through the process of configuring the requirements of the Fitter Snacker company in SAP. Through these exercises, students better understand how to dissect a business process, and can apply this knowledge to the use of other service delivery strategies, such as web services and grid computing. It is usually through an "ah ha" process that students fully understand what integration means. Finally, the third segment, benefits, risks, and trends, uses the Shanks, Seddon, and Willcocks [2003] collection of ES research articles and Harvard Business School case studies.

ES I has been a success for three reasons: first, all three segments are supported by well-established curriculum; second, two of the segments involve hands-on ES use, which is particularly popular with students because this experience-based learning re-enforces the concepts; third, this course is of particular interest to many recruiters because students have developed not only richer knowledge, but also valuable skills. Faculty members who offer this (packaged) course are not burdened by the earlier challenges of having to spend exorbitant time on curriculum development.

The Enterprise Systems II course continues to evolve and takes advantage of advanced application curriculum materials in the areas of customer relationship management, business intelligence, supply chain management, strategic enterprise management, and portals. Most recently, curriculum was developed in the area of corporate governance and enterprise systems audit and was delivered at an SAP faculty workshop this past summer. The process planning and control course takes advantage of materials from the SAP Innovation Watch repository [http://service.sap.com/iw], as does the Data Warehousing Course.

In addition to the four courses listed in Table 3, students also work on independent study projects to acquire deeper knowledge and skills. For example, students are currently studying supply chain optimization (using APO, the Advanced Planning and Optimization module), customer relationship management (CRM), strategic enterprise management (SEM), enterprise application integration (EAI) and Portals components. In addition, graduate students are required to write a thesis, which often involves advanced study in a specific ES area.

History of Courses and Faculty
LSU has experienced substantial changes in its ES-enabled course offerings over the years. A number of ES-enabled activities at LSU are described below because these ideas, and LSU's experience with them, may be of use to other schools.

- In the mid-1990s, the Systems Analysis and Design course started to place greater emphasis on business processes, enterprise application development, and ERP implementation through the use of SAP. Previously, students developed application software for processes for which they had no real-world experience. Using SAP-provided hands-on experiential learning exercises forces students to think through the core business processes in detail (e.g., customer order management and procurement) in addition to related information such as data requirements, information flows, and process steps.
- In a Business Process Reengineering course using Harvard Case Studies and Davenport's [1993] book, students developed an appreciation of work life without processes, and work life with integrated, stream-lined, technology-enabled processes. Case studies demonstrated broken processes, innovative processes, and

        how to move an organization from the former to the latter. Students used the SAP Best Practices repository to reengineer business processes in collaboration with actual business and government organizations.

- An Enterprise Application Development course was offered, in which students created a simple airline reservation system in an ES development environment. Students developed skills in using the ES development tools and better understood application development in this environment. They also discovered that developing ES applications was not as simple as coding in C on their desktop.
- SAP was used as the platform for a student project on global, virtual collaboration. Students from three continents (North America, Australia, and Europe) formed global ERP implementation teams. Together they collaborated to define and implement business processes to support a hypothetical company [Rosemann, Scott, and Watson, 2000].
- A local (Louisiana) coffee company was the site for a prototype SAP implementation. Students modeled a simple supply chain: coffee beans purchased from foreign countries were shipped to New Orleans, trucks carried the raw material to the Baton Rouge processing facility where the coffee beans were processed, packaged, and stored in local warehouses for distribution to retail locations. Students worked in functional teams to define the business process requirements and to implement these processes in the SAP R/3 System. Students quickly realized the dependencies among their functional areas.
- In an Enterprise Application Integration project, students developed Java front-end order management applications and "connected" this front-end retail site with SAP R/3 using WebMethods EAI interface.

As illustrated above, teaching with an ES provides many opportunities for innovations in curricula. On the other hand, the feasibility of these opportunities is limited by the availability of teaching resources. The SAP UA program has simplified this process over the years, but there is still a significant commitment on the part of the faculty when working with a real ES.

Reflection on the LSU Program

In contrast to the continually growing ES-enabled curriculum at CSUC, LSU has evolved through four distinct stages in its participation in the SAP UA program. Stage I, the "start-up" stage, occurred in 1997 and was a period of excitement and ambition. The early years of LSU's membership in SAP's program was marked with a steep learning curve, a significant amount of experimentation, and a bit of frustration dealing with curriculum and technology challenges. Faculty members in this program experimented with many different approaches to teaching and learning, spent many weeks in SAP training classes geared towards industry end-users rather than academics, and spent many weekends working out technical problems to ensure working hands-on exercises.

Stage II, "growth and maturity", occurred in 1998-1999. LSU then had six faculty members exploring SAP including faculty from ISDS, Accounting, Management, and Marketing. Emphasis was placed on business processes, ES implementation, application development and systems administration. Many students enrolled in the IS program and undergraduate enrollment boomed from under 100 to over 600, an explosion experienced by IS programs. In this environment, graduate students, leaving $30k/year jobs might receive $70k+/year salary offers from consulting organizations due in large part to their knowledge and skills gained from SAP-enabled courses.

Towards the end of this era, though, recruiters reduced their heavy campus recruiting of ES talent. At the same time, belt-tightening forced many schools to reevaluate the investments necessary to sustain an ES-based program. Most faculty members involved in the early years have since left LSU and it has been difficult to attract newer faculty with an interest in teaching with ES. From a recruiting perspective, although the demand for "ERP students" in consulting organizations had dwindled, recruiters from other private and public organizations began to

inquire about LSU's students' exposure to, and knowledge of, ERP, particularly SAP. Meanwhile, SAP recognized that the costs associated with UA membership (e.g., infrastructure and manpower resources for systems administration, curriculum development, and UA membership) were becoming increasingly prohibitive for many schools. Subsequently, SAP began the development of an ASP model to serve universities in the UA program.

Stage III, the "awakening", occurred during 2000-2001. During this time, SAP developed five University Competence Centers (UCC) to host SAP software for other universities; LSU and CSUC to name just two. SAP revised their curriculum grant awards program to focus on delivering sustainable curriculum that could be readily shared. They also introduced Faculty Workshops, taught by University Faculty, to replace SAP training. These workshops provided faculty members with hands-on skills, tested curriculum materials and hands-on exercises. The SAP UCC model significantly brought down the costs of systems administration and curriculum development, and brought relief to faculty members who were becoming wary of the curriculum development efforts involved with program participation. Additional information regarding the SAP UCC is presented later in this paper.

Stage IV, LSU's current stage, is marked by a stable, affordable, and effective UA program. There is renewed excitement over the availability of advanced (strategic) applications, such as CRM, SCM, SEM, and Portals. LSU recently reported its attempts to measure learning outcomes and advantages of using an ES in an Operations Management course [Nogueras and Watson, 2004]. Finally, faculty members at LSU and around the country are realizing that their research can benefit from their involvement in these programs.

In summary, LSU faculty members continue to spend time listening to recruiters and adjusting curriculum to better prepare students for the marketplace. Overall, LSU has found that including a hands-on component in a course makes the abstract more concrete and exposes students to the otherwise ignored challenges of dealing with real systems in the real world. Students working with real systems develop deeper knowledge, more confidence, and useful skills that ultimately help them to better understand the difficulties associated with ES adoption and effective use in an organization.

QUEENSLAND UNIVERSITY OF TECHNOLOGY

Motivation and Focus

QUT has been teaching packaged software selection and implementation since 1990. It sought to make this process more realistic and, in 1995, commenced discussion with ERP vendors about embedding their software in the graduate curriculum. The first subject with vendor specific material was Information Technology Management in which the elements of software discovery, selection, implementation, and continuous improvement were introduced. A formal graduate course on Enterprise Software was developed by the author from QUT in 1997 and the number of courses expanded to the current level of 16. QUT now offers a wide range of study options to its undergraduate and post-graduate students in Business, Engineering and Information Technology.

Courses and Faculty

The current structure for the subjects offered in the Faculty of Information Technology is shown in Figure 1. There are two streams of study: the technical stream of developing or refining enterprise software, and its management, and the business strategy stream of selection, application, implementation, and business improvement. Student enrollment in these courses has been high, as the data in Table 4 attests. Course details for the enterprise systems streams are briefly described next, followed by a brief description of courses found within the Faculty of Engineering and Faculty of Business respectively. Note that there are additional technical courses relating to Enterprise Systems which are not described as they occur in other streams. These courses are: Enterprise Data Mining, Web Services for Enterprise Systems and Development in a J2EE environment.
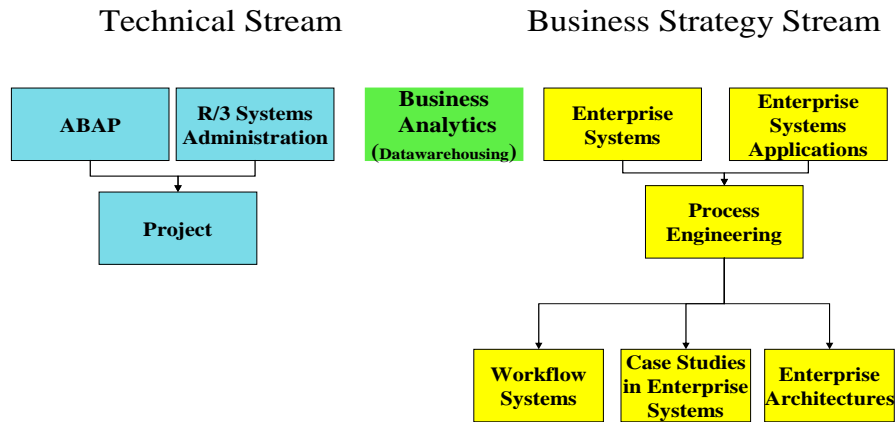
Technical Stream   Business Strategy Stream

Figure 1. ES Courses within QUT's Faculty of Information Technology

Technical Stream. The ABAP[1] course commences with introducing the characteristics and features of the ABAP workbench environment. It then introduces ABAP data modeling tools and ABAP language basics. The focus of the course is on principles of report and screen design. Students develop reports and dialogue screens in ABAP enhancing transactions in SAP R/3.

Table 4. Enrollments in QUT's Faculty of Information Technology Courses, Totals for 2000-2005

Course	Enrollment
ABAP	593
Business Analytics	186
Industry Project	163
Enterprise Architectures	223
Enterprise Systems	1,892
ES Applications	916
Process Engineering	408
R/3 Administration	639
Total	4,940

The R/3 Systems Administration course provides a practical introduction to the essential tasks of the R/3 systems administrator. It introduces the theories relating to performance monitoring and management, database management and tuning, user management, and systems planning. Students are able to apply these theories to any complex system requiring systems

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[1] ABAP (Advanced Business Application Programming) is a high level programming language created by the SAP company. Its syntax is somewhat similar to COBOL (Wikipedia, http://en.wikipedia.org, accessed January 10, 2006).

administration, data administration or security management, and graduates from this course are employed in Oracle, Peoplesoft, JD Edwards and SAP sites globally. The major output from this course is a well structured systems administration manual capturing the major systems tasks and problem solving strategies.

Business Strategy Stream. The Enterprise Systems course introduces the ES lifecycle, implementation processes, implementation issues, and discusses integration with other systems (legacy and specialist). It also introduces the technical Architecture of SAP R/3 as an exemplar enterprise system. It provides a process walk through functional boundaries — spanning financial accounting (FI), materials management (MM), production planning and control (PP), and cost management (CO) — so that IT students have a better understanding of the functionality of such complex systems. It closes with a case study critique of an actual implementation.

The Enterprise Systems Applications course uses SAP as an example of an enterprise system. It focuses on the core modules within these integrated systems and provides students with the theory and practice relate to the financial accounting (FI), cost management (CO), materials management (MM), sales and distribution (SD), production planning and control (PP), and human resources (HR). The course provides an overview of the business use of these components, their functionality, and their integration within an ES.

The course on Business Analytics and Data Warehousing introduces the theories of data warehousing and data mining, and gives the students practical experience with SAS to integrate heterogeneous data sources and provide formatted business reports.

The Process Engineering course introduces students to business process reengineering, business process management, and business process maturity management. A key topic is Business Process Modeling which uses the ARIS[2] approach to provide a deeper understanding of the methodologies and tools needed for effective process modeling. The course then examines process-based Enterprise Systems Management and shows how the ES lifecycle phases of selection, implementation, and benefits realization are enabled through process modeling and management. Students are given case studies in process engineering and develop a mini-case of their own. The Workflow Management course complements Process Engineering by introducing students to workflow engines and the mathematical methods behind workflow modeling.

The Enterprise Architectures course is used as a starting point for graduate students and the capstone course for undergraduate students (beginning in 2006). Its purpose is to provide the student with a holistic understanding of the inter-dependencies between the business architecture, the application architecture, the information architecture, and the technology architecture. Issues of business-IT alignment are developed through the linking of business strategy and objectives to business processes, and the linking of business processes to the underlying application portfolio base. Students develop a level 1 enterprise architecture planning document for a target organization.

With this background, students are then able to apply their knowledge of Enterprise Systems and Process Engineering to a real problem occurring in an industry setting. Students work to provide improved processes in a thirteen week period. They commence modeling the existing target process, using the ARIS toolset, and then refine the process for significant improvement. Over 190 students have worked with approximately 15 industry partners over the last five years in this fashion. Many graduates from this course are now working globally as consultants.

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[2] ARIS (Architecture of Integrated Information Systems) is a method for analyzing processes and taking a holistic view of process design, management, workflow, and application processes (Wikipedia, http://en.wikipedia.org, accessed January 10, 2006).

Integrating the Curriculum

While most of QUT's ES-enabled courses are offered by the Faculty of Information Technology, the Faculty of Engineering and the Faculty of Business also offer ES-enabled courses. The Faculty of Engineering offers a course on Enterprise Requirements Planning as part of its Master of Engineering Management. The aim of that course is to provide students with an understanding of the underlying philosophy and practice of resource planning. Topics covered include the following: functions and inter-relationships between the major components - demand analysis, production and operations planning and control, resource planning and control - manufacturing requirements planning (MRPII); supply chain management; and total enterprise approach to business management. These principles are applied to the processing and service industries such as mining, oil, chemical, and food processing, hospitals and airports.

The Faculty of Business introduces students to computerized accounting information systems through using MYOB [http://myob.com]. Subsequent courses in Enterprise Systems and in Computer Security and Audit extend this understanding to more complex systems, and give students experience in an SAP environment.

The AIS course introduces the nature of enterprise resource planning systems (ERP) and focuses on advanced study of accounting information system cycles. It links these concepts to the SAP R/3 FI, Financial Accounting Module functionality, and specifically provides experiences in general ledger accounting, sub ledger accounts, accounts receivable, accounts payable, and authorizations for the FI Module. This course concludes with exercises in customizing the FI Module and integrating with the CO - controlling module.

The Security and Audit course focuses on controls and auditing, general controls, application controls, generalized audit software, and static and concurrent computer-assisted audit techniques. This subject on Security and Audit is extended in a course on Financial Forensics and Business Intelligence which develops analytical skills using SAS to detect intruder patterns.

Reflection on the QUT Program

These curriculum experiences demonstrate that many different application systems can be used to provide students with practical experience related to the underlying theory. QUT avoids over-specializing in one system and seeks to ensure that students understand that the skills are transferable to other systems used in medium and large enterprises.

The critical success factors for these courses stem from the commitment from staff to train in the packages, to see the curriculum differently, and to develop robust, industry strength material. Our graduates are very well placed to compete in the international market place based on the design and execution of this curriculum.

To maintain its competitive edge, QUT's curriculum is constantly updated. It is currently moving more towards deeper understanding of the modeling, analysis, and design elements required to exploit business benefits from large system investments. This curriculum work complements the research program underway at Queensland University of Technology into Business Process Management, Enterprise Systems Success, and Workflow Management Systems. Web site addresses with further information on these programs are listed at the end of the paper. Further information also can be found in a series of papers written about QUT's experiences of teaching with ESs, e.g., [Stewart et al., 1999; Stewart and Rosemann, 2001; Stewart et al., 2002; Stewart, 2004].

Finally, note that access to a system is essential. In the past, access meant that the academic had to manage the technology, as well as creating the curriculum experience. This has been found to be too time consuming, too complex, and too costly in terms of equipment. Indeed, most institutions are moving towards purchasing access through a hosting center, such as SAP's international University Competency Center model. Academics only require assured access to a dedicated logical system in order to provide an enriching experience for their students.

Providing this experience, however, does come at the cost of maintaining an understanding of the complex system with which you teach. There are training costs involved, but QUT has learned to stay distanced from the detailed functional knowledge, and to focus on those elements that add value to understanding the application of theory to practice. This is not an easy task and requires substantial commitment from staff and the vendor.

Close and collaborative links with industry partners is an essential ingredient for bringing current case studies into the classroom. Fostering these relationships takes time. All of these elements are worthwhile to maintain the competitive edge for the students and to ensure that the courses are both theoretically rigorous and industry relevant.

BENTLEY COLLEGE

Motivation and Focus

Bentley College has a long tradition of integrating business applications of information technology into its curriculum. Its unique positioning as a "business university" enables the institution to closely coordinate teaching and research within this narrow focus. The Bentley Mission identifies *Business and Information Technology* as one of the College's strategic domains for curriculum and research. Within this setting, the initiation of a cross-curricular ES program was considered key to providing students with an intensive introduction to the technologies, business processes, and work styles they would encounter after graduation.

A committee was formed in 1998 to identify the best ERP for curricular use. SAP was chosen because of its leadership position in industry (which it maintains), as well as the excellent academic support offered through the UA program. Six members of the faculty from a variety of business departments attended a weeklong introduction to SAP held at CSUC that summer. Bentley committed sufficient hardware, staffing, and faculty development resources to support a significant implementation across a number of courses and programs. The primary focus of the implementation was the newly designed cohort-based "Information Age MBA program", in which a business process focus replaced traditional functional area instruction. Along with the MBA, a new program in Accounting Information Systems became a natural home for SAP use. Over time, as these programs matured, SAP's role remained central for hands-on illustration of business process concepts and the role of technology from a user or evaluator perspective (e.g., as an IT auditor). Currently, there are no implementation or configuration offerings for those interested in developer positions.

In 2004, Bentley moved from a self-reliant installation to the Drexel University host. There were several reasons for the move. Staff support to ensure high reliability during peak student demand time is very difficult to maintain in a university environment. As faculty became more sophisticated in their use, they requested access to several "sandboxes" for development and testing, each of which adds to the cost and complexity of the installation. In addition, SAP no longer supported the currently installed version of the software and sample data base. The hassles of transition to the new version coupled with faculty interest in adding new, extended ES modules, and capabilities made a move to the Drexel UCC very attractive. This move has reduced the challenges associated with supporting hardware and configuring the installation to work with the range of courses expecting access. The hosting institution acts as a repository for course requirements, faculty requests, and version control. Equally important is the high level of system availability afforded by a shared environment.

Courses and Faculty

Since its initial use in an Advanced Accounting Information Systems course in 1999, SAP has been included in courses in four undergraduate majors (Accounting, Accounting Information Systems, Accounting and Finance, and Finance) and four graduate degree programs (MBA, MS in Accountancy, MS in Accounting Information Systems, and MS in Finance). Tables 5 and 6 list the course titles of offerings within these degree programs. Titles in italics refer to courses that

have included SAP content in the past, but do not in their current version. (This is primarily due to a change in instructors, as current faculty members without SAP experience often refrain from retaining ES content.)

Table 5: SAP in the Bentley Undergraduate Curriculum

Accounting *and* Accounting Information Systems Majors *(required courses in one are electives in the other)*	Finance and Accounting Major *(a joint major)*	Finance Major
Accounting Information Systems	Corporate Treasury Management	Corporate Treasury Management
Financial Accounting and Reporting I (aka Intermediate Accounting)	*Financial Accounting and Reporting I (aka Intermediate Accounting)*	
IT Audit	Performance Measurement and Evaluation	
Cost Management	Cost Management	
Advanced Accounting Information Systems		
Advanced Topics in Cost Management		

The Accounting Information Systems course illustrates the linkages Bentley has made between SAP use and course content. This course emphasizes the Order-to-Cash and Purchase-to-Pay business processes (and therefore the Sales and Distribution (SD), Materials Management (MM), and Financial Accounting (FI) modules within SAP). The specific business processes enacted through the International Demonstration Education System (IDES) database, which contains the sample data provided by SAP with the R/3 system, are followed by the students, which gives them both hands-on experience with the software and a good understanding of the challenges and benefits of tightly integrated systems. The students are asked to apply course documentation skills (e.g., systems flowcharts and data flow diagrams) to the processes they study, and they assess the internal controls enforced through the software. They are then able to contrast this experience with the material in the textbook and with the business process they study at an area business in a large-scale course project. In addition, students are shown a video of SAP as used in the distribution facility of Boston Scientific, in which they can see where and when warehouse employees use the software to acquire, shelve and ship products. (Contact ugelinas@bentley.edu for information about the video.) Here again they identify the integrated business process, IT, and control issues implicit in the receipt and sale of medical supplies and equipment.

Table 6: SAP in the Bentley Graduate Curriculum

MS in Accountancy and MS in Accounting Information Systems	MBA	MS in Finance
Business Processes and Systems Assessment	Business Process Management (I and II)	Short-term Financial Management
Advanced Accounting Information Systems	*Financial Statement Analysis for Decision-Making*	
Financial Accounting Problems I	Management Consulting Teams	
IT Audit	All other ES courses may be taken as electives	
Auditing SAP (one-time offering as a Special Topics course)		

In the Finance area, two advanced courses use SAP. The Short-term Financial Management course focuses on the Treasury module of SAP. Because of the lack of useful sample data in IDES, this faculty member created a new data set that runs on its own copy (or instance) of SAP. In order to get the Treasury exercises to work, the instructor needed to customize the data base and the configuration, including setting business areas and cash management account names, adding G/L accounts to groupings that get called up by the Cash position report, and creating posting rules and assignments to handle check clearing and bank statement clearing. More generally, this experience demonstrates that an instructor must be very familiar with the software and its configuration to extend its use to an area that sample data do not support.

The Performance Measurement and Evaluation course includes work with SEM (Strategic Enterprise Management), BPS (Business Planning and Simulation), the Balanced Scorecard, and the Management Cockpit. It features a three-campus, international budgeting exercise using SEM and BPS. The other participating institutions are CSUC and HES in Amsterdam. Future plans include more exercises on the Balanced Scorecard, such as a risk assessment exercise and an exercise on Value Based Management (EVA). Both courses are soon to include query based exercises using some of the infocubes in BW (the Business Information Warehouse).

In addition to hands-on work with SAP in their year-long interdisciplinary Business Process course, MBA students also evaluate a fictitious company's ES business process implementation challenges [Usoff and Gelinas, 2005]. MBA students sometimes find themselves working with SAP or on a SAP engagement in the Business Process group project or in the consulting team projects that are undertaken by all full-time students.

Further examples of course learning objectives and ES content at Bentley can be found in Fedorowicz et al. [2005].

Integrating the Curriculum
Bentley's ES-enabled courses offer some curriculum integration across the eight different graduate and undergraduate degree programs in which courses are offered. The focus, however, is primarily on accounting and finance courses. There are no CIS department courses that cover

ES configuration. However, SAP may soon be introduced to all undergraduates in the required CIS course, perhaps using the Fitter Snacker exercises (http://service.sap.com/iw). The Marketing department is also working on a course that would incorporate CRM exercises.

Although most of the courses are in accounting or finance, the large number of courses means that some coordination is required. The faculty teaching ES courses communicate and meet often as a group to coordinate course content and SAP coverage in order to minimize overlap and ensure adequate coverage of basic topics. Each course has its own set of learning objectives for the ES modules, and the faculty collaborates on assignments and tailors any shared hands-on material to course-specific content.

Students may take the SAP-based courses in any order, creating a challenge for instructors to not repeat introductory material to seasoned users. As a result, an introductory workshop was developed that cuts across all courses and programs. Students are required to take the workshop when they first enroll in an SAP-based course. These workshops are taught by graduate students with an SAP background, who also serve as a resource to students who encounter problems while working in campus labs.

Reflection on the Bentley Program

In addition to course offerings, the alignment of ES with Bentley's strategic focus on business and IT has led to a number of internally-funded research projects around ES design and use in the field. These projects serve as material for further course enhancement and have led to interest among several faculty members to offer ES-based courses in their own areas, such as Finance, CIS and Marketing. As course offerings grow, the SAP faculty group will continue to meet to coordinate the options available in each of the programs and to add to the experiences open to all students.

There are many practical lessons to be learned from the Bentley experience. Many of these are recounted in a recent article [Fedorowicz et al., 2004] in which twelve tips for the successful integration of ES into a curriculum are provided. The advice covers four main topic areas, including specific ways to learn from the success and failure of others (such as the programs contributing to this article), curriculum and implementation issues, training and outside support, and student and faculty related issues. The bottom line is that ES integration is time-consuming and sometimes frustrating, but the benefit to the students is tangible and worthwhile.

WORCESTER POLYTECHNIC INSTITUTE

Motivation and Focus

Compared with the other four schools represented on the panel, WPI began later to integrate Enterprise Systems into its curriculum and the effort is still very much a work-in-progress. WPI's ES curriculum project grew out of a research project. A team of WPI researchers started studying ES-enabled organizational changes via longitudinal field studies in 1999. This effort, which was funded by the National Science Foundation [Strong, Elmes and Volkoff, 2001], produced a number of research papers, e.g., [Elmes, Strong, and Volkoff, 2005; Luo and Strong, 2004; Strong and Volkoff, 2004; Volkoff, Elmes, and Strong, 2004; Volkoff, Strong, and Elmes, 2005]. Equally important, this research project produced a conviction that the nature of work in medium and large-sized organizations had changed, and thus it was critical that undergraduate management and engineering students have some experience with working in an Enterprise Systems environment before graduating.

The WPI ES curriculum project started from the following observation:

"Companies need employees who are able to use integrated ES data to make decisions [Davenport et al., 2002], to understand the impact these decisions have throughout integrated processes, and to recognize opportunities for improving integrated process performance. Yet, our students rarely see

integrated computer applications. They do not understand integrated process operations and supporting data and they lack the ability to work in an integrated, data-rich environment." [Strong, Johnson, and Mistry, 2004, pp. 301].

The objective is to teach students about the integrated nature of the business processes in organizations and how to work in an integrated, data-rich environment. This fits well with WPI's focus on the Management of Technology within its management programs. All graduate and undergraduate degrees within WPI's Department of Management explore the interdependence of technology and the management of organizations. The Department of Management has 21 faculty members and covers all disciplines of management, including accounting, finance, organization science, MIS, etc. as well as industrial engineering. Its mission involves a commitment to providing education, research, and outreach that focus on leading and managing technology-based organizations; integrating technology into the workplace; and creating new processes, products, services, and organizations based on technology. The decision to initiate a project to integrate ES into WPI's core management curriculum, as well as into the engineering curriculum, fit well with the mission of WPI's Department of Management and the critical role of ES in today's organizations.

WPI chose the Oracle ES suite for several reasons. Oracle includes all the typical modules needed in an organization, but is smaller and less complex than SAP. Given the small size of the Department of Management at WPI, this was important. It is second only to SAP as the most popular package in the market. In addition, Oracle was less costly than SAP. Thus, WPI expected that Oracle would provide all the educational benefits of integrating an ES into the curriculum while reducing the costs and complexities of the project. Furthermore, at the time, SAP had not yet moved to a hosting solution and WPI's computing center had expertise with the Oracle database and an ES that runs on Oracle (the Banner system, an ES designed for educational institutions). Thus, the computing center was willing to host the Oracle package.

Courses and Faculty

WPI's strategy for integrating ES into its curriculum is to develop ES-based decision making modules that are used by students in labs attached to traditional courses. These modules are designed to engage students in making decisions in the integrated, process-oriented, data-rich environments common in today's organizations. This strategy requires few changes to existing courses, and also has the advantage of minimizing the ES knowledge needed by faculty to teach with ES.

Given WPI's user focus, rather than a developer or systems integrator focus, the core project team is interdisciplinary consisting of one MIS professor, one accounting professor, and one operations and industrial engineering professor. The pilot project involved two courses, managerial accounting and production planning and control. The full set of courses for which modules have been developed or are under development is listed in Table 7.

For the managerial accounting course, a budgeting lab was developed to support a budgeting case already used in the course. Students went to two lab sessions; the first was an overview of the Oracle Applications Suite and an introduction to navigation in the Oracle suite; and the second was the actual budgeting lab in which students developed a budget in Oracle and did the what-if analyses needed for the case. Both sessions were run by a senior undergraduate student.

In addition to developing modules, WPI is also measuring changes in student understanding of course material due to the addition of the ES-based modules. Measurements include performance on exams covering ES-supported topics, e.g., budgeting in the managerial accounting course, as well as students' computer self-efficacy [Compeau and Higgins, 1995]. For the managerial accounting course, students learning material supported by the ES performed significantly better than students learning material without the ES [Strong, Johnson, and Mistry, 2004].

Table 7. ES-enabled Courses at WPI

Area	Course
Accounting	Managerial Accounting
Operations and Industrial Engineering	Production Planning and Control
Management Information Systems	Enterprise Systems (Graduate)
	Managing the IS Function
Marketing	*Marketing Management
Mechanical Engineering	*Materials Selection and Manufacturing Processes

*Modules for these courses are under development for offering in 2006-07.

For the production planning and control course, two labs were developed that focused on decisions related to inventory planning and control. Like the managerial accounting course, students attended an introductory lab session and then the two decision-making labs, all of which were run by a senior undergraduate student. The students running the labs also assisted the core team in developing the decision making modules. To date, all the labs are using the Vision database that is shipped with the Oracle ES package to provide the data to support these labs. For more information on WPI's ES curriculum project and the success of the pilot project, see [Strong, Johnson, and Mistry, 2004].

Two ES courses for the MIS curriculum, one for graduate students and one for undergraduate students, have also been developed. These courses focus on the managerial aspects of installing and using ES in organizations, based on the knowledge gained from our research projects. They also have associated labs that use decision-making modules, both newly developed modules and those developed for the pilot project. Both of these courses use readings and cases, rather than a textbook.

Integrating the Curriculum

A proposal to develop additional decision-making modules, as well as a case and supporting data was recently funded by NSF [Strong, Johnson, and Mistry 2005]. In addition to developing an integrating case and an associated database, the two pilot modules will be improved, a variance analysis module for the managerial accounting course will be developed, and two new decision-making modules, one for the core marketing course and one for a mechanical engineering course, will be developed. The case places these decisions in the context of two organizational processes: the product development process and the supply chain and order fulfillment process. The business case and the associated data serve as an integrating mechanism across the curriculum since all students in courses with a decision-making module will see the same case.

The major focus of WPI's ES project is these four courses: Managerial Accounting, Production Planning and Control, Materials Selection and Manufacturing Processes, and Marketing Management, all of which are outside of the MIS curriculum. That is, WPI is starting from an integrated curriculum approach by including courses from Accounting, Operations and Industrial Engineering, Mechanical Engineering, and Marketing.

Reflection on the WPI Program

The WPI team believes that the approach of ES-based decision-making modules in the form of labs will be easier to implement across courses in the management and engineering curricula both at WPI and at other schools because it reduces the need for curriculum revision and the need for extensive faculty training in the ES. The focus is on decision-making in an integrated, data-rich environment provided by an ES, rather than on learning the ES itself. Thus, the decision-making modules are being integrated into accounting, operations, marketing, and engineering courses, rather than information systems courses.

Although the decision-making modules are developed using the Oracle Applications Suite, which includes Oracle Financials as well as modules for most other business functions, e.g., manufacturing, engineering, and HR, the decision-making modules should be appropriate for other ES packages. As part of the NSF-funded project, the WPI team plans to test this using the Great Plains software from Microsoft and will evaluate their appropriateness with SAP as well.

III. ADVICE FOR OTHER SCHOOLS

The audience for the AMCIS 2005 panel had a number of questions. The questions and the panelist responses are grouped into three general issues: choosing an ES software package, the availability of course material such as textbooks, and whether students received certificates documenting their knowledge of an ES package.

CHOOSING SOFTWARE PACKAGES

Given that four of the five schools represented on the panel were using SAP, the question was whether other packages were or should be considered. Before presenting responses about each school's choice of software packages, we provide some background on the academic programs provided by SAP and Oracle.

ES Vendors and their University Support Programs

SAP, the leading ES vendor, has a University Alliance Program, which has evolved as SAP realized the difficulties of integrating SAP into a university curriculum and the costs to universities of supporting the SAP software. SAP leveraged the significant early investment at universities such as CSUC by creating University Competency Centers (UCCs), which provide networked hosting solutions for other universities. CSUC, LSU, and QUT became UCCs, while Bentley chose to use the UCC at Drexel. Through these UCCs, the SAP UA is able to provide member schools access to R/3 or mySAP.com clients (instances) for an annual fee of $8,000. Hosted schools (those using a UCC's services) are able to bring SAP into their curriculum for a fraction of the start-up costs required at groundbreaking universities such as CSUC, LSU, and QUT.

In addition, the SAP UA acts as a clearinghouse for distribution of course materials that have been developed over the years both by SAP and faculty at member institutions. The SAP Innovation Watch curriculum repository contains faculty-developed courses in many areas. The SAP Faculty Workshops, with free registration, provide very good instruction on the use of a particular curriculum in the classroom. The workshops are led by faculty and utilize materials that were developed, in most cases, by the faculty delivering the course. These workshops contrast with the early years when participating faculty took SAP training classes geared to business and government, and then developed curriculum material on their own. The SAP Academic Congress brings together faculty who either participate in the program or who are interested in participating in the program and educates them on available curricula, newly released curricula, and future product developments.

The SAP environment includes the IDES database, which has a substantial amount of data covering standard processes. It is not enough, however, for all concepts, e.g, Bentley added more data for its treasury course. More data are also needed to support teaching about CRM or SCM activities.

Oracle, the second largest vendor of ES software, has its Oracle Academic Initiative (OAI). The OAI is best known for providing the Oracle database package to schools for teaching purposes for an annual fee of $500. When Oracle started providing its ES package, the Oracle 11*i* e-business suite, to schools for teaching, it charged an annual fee of $500, which has been raised to $3,000. Oracle does not provide as much support as SAP does, e.g., it does not have special training for educators nor a curriculum repository. The Oracle e-business suite includes the Vision database, which is populated sufficiently to teach Oracle's training courses. These data are sufficient for some courses, but may require additional data for specialized exercises. While Oracle does not provide as much support as SAP, the package is less complex and the fee for joining the academic initiative is cheaper. Each school, however, must host its own software.

Choosing among ES Software Packages

LSU chose SAP at the time for three reasons: popularity, availability, and support. In the mid-1990s, SAP was by far the most widely-used ERP package. The company adopted the successful UA model from Germany and made a clear and significant commitment to supporting higher education curriculum integration initiatives. There is also a large amount of SAP-related learning material available from the company, third-party software and consulting vendors, and independent book companies such as Barnes and Noble and Amazon.com. Finally, through its UA program, SAP provides comprehensive support to faculty, e.g., faculty have access to an on-line curriculum repository, free faculty workshops, an annual academic Congress, access to ERP and e-Business applications, and a curriculum helpdesk.

QUT, in addition to its SAP program, also has Oracle and SAS. Oracle is used mainly for database courses and SAS mainly for datamining. In addition to SAP, QUT approached Oracle Financials, as well as Peoplesoft and Microsoft Business Solutions, but SAP expressed the most interest in being a partner. QUT has been satisfied with the relationship with SAP. In addition, as a research institution whose research covers ERP issues it has benefited from SAP's R&D funding.

Bentley primarily uses SAP as its ES teaching platform, but does introduce its introductory accounting students to the Peachtree software suite, which is free and very easy to use. Peachtree gives students hands-on experience with the concepts of ES without extensive time and training. Bentley has also used Great Plains, which is now owned by Microsoft. It also supports Deltek Advantage, which is an ES for companies that are project-oriented (e.g., accounting, architectural and law firms). Oracle is used as the database platform for SAP and the CIS database courses.

WPI chose Oracle because of cost and size. Since Management at WPI includes a total of 21 professors, it concluded that the size and cost of SAP would be too much. At the time WPI was choosing a package in the late 1990s, SAP had not yet converted to its UCC model and was also asking universities to send about seven faculty members for training. On the other hand, the Oracle Applications Suite was available for $500 per year with no requirement on initial faculty training. Oracle's package was comprehensive in its coverage, but less complex than SAP. Furthermore, WPI's computing center had Oracle experience and was willing to host the Oracle package.

The Importance of Software Choices

There is little motivation for schools to teach with multiple ES packages as recruiters have said that the particular package does not matter; it is the ES concepts learned by students that are valuable to companies and that knowledge is transferable. The main argument for multiple packages is to refute those who say the school is married to one vendor and is teaching that vendor's package, rather than educational concepts. For example, many graduates of SAP-based curricula are working for companies that utilize Peoplesoft, Oracle or others. At QUT, the curricula also have guest lectures from other vendors to be sure students are exposed to other solutions. Specifically, the particular vendor should not be included in the course title or description, i.e., do

not call it a SAP course, but an ES course. Since an ES provides a hands-on experiential learning environment, having an ES-enabled learning environment available to students is important for their learning, but which ES package is chosen is much less important for student learning.

Since one goal of the curriculum should be teaching students how a business actually works and concepts about integration of the business, other tools, in addition to an ES package, may also be useful. Bentley has found that process integration concepts are much clearer to students in business process courses when such courses include the use of an ES. Bentley uses the Process Modeling tool in addition to SAP so the students see the process theoretically as a model, and then its actual implementation in SAP. QUT has been teaching process engineering since 2000 and uses ARIS from IDS Scheer as its modeling tool. QUT is moving into Net Weaver and will be developing curriculum around the process integration element (XI) and is currently structuring graduate projects around that environment. A key issue is not exhausting your faculty and staff with learning too many tools.

TEACHING MATERIALS

In addition to the software, faculty members teaching with an ES also need teaching materials beyond the training material provided by the vendor. One question from the audience was about the availability of textbooks and instructional material.

QUT uses and recommends the Calvert workbook to its client universities seeking to have a relatively easy introduction to integrated processes. This workbook uses the IDES data and walks through some standard processes in Accounts Payable, Accounts Receivable, Sales and Distribution and Materials Management. Some configuration activities are provided for Sales and Distribution. Some course developers choose not to start with the IDES system and actually involve the students in building the database as part of the exercises. Some courses involve a setup process that populates the company database with just the data necessary to support the particular course. This is convenient as students do not get lost in a sea of data. In any case, a technical support line and curriculum support line are available to faculty participants.

Bentley has adapted material from training experiences and has developed some of its own. None of the hands-on material that Bentley uses is from textbooks; faculty members develop their own material or adapt it from other sources, e.g., SAP training materials and materials from CSUC. One of the advantages of working collaboratively in curriculum development is sharing materials. In the early days of teaching with ES, there were no textbooks and developing course material was a lot of work.

Bentley students use the IDES database, other faculty created data sets, and also generates their own data entries. Each semester, a clean version of the sample data is refreshed to permit students to create additional data based on a hypothetical, yet operational, company. Because the faculty users coordinate the use of copies of the database, changes made in one course can support the learning by another set of students.

WPI is developing its own material for its ES-based decision making modules. The courses using these modules continue to teach with their existing textbooks and cases. The MIS and IT classes that focus on enterprise systems use ES and business process readings, as well as Harvard and Ivey cases.

In the SAP UA program, there are a number of hands-on "experiences" that are well documented and available to members to support ES-enabled courses. Monk and Wagner [2006] provide a superb overview of business processes with and without an integrated system, using the Fitter Snacker hypothetical health food bar company. Hands-on SAP exercises, developed by one of the co-authors (Wagner) and available on SAP innovation watch (IW) [http://service.sap.com/iw], guide the student through a user-view of basic business processes (e.g., sales, financials, supply chain, human resources) using an integrated system. A second set of exercises is available that guide the student through the process of configuring SAP to match Fitter Snacker business

requirements. Tracy [2005, personal communication] provides a similar experience in the form of workbooks, available through SAP IW. In a similar course in the Netherlands, students are grouped into functional teams and led through the implementation of an SAP system using hypothetical business requirements [Schenk, Draijer, and Caris, 2004]. There are also several other ERP books that are not tied to a specific vendor, e.g., [Kirchmer, 1998; Sandoe, et al., 2001; O'Leary, 2000; Sumner, 2005; and Davenport, 2000, 2002]. These books have been used successfully in concert with hands-on experiences.

DOCUMENTING LEARNING VIA CERTIFICATES

One audience member asked whether schools provided certificates to students in ES-related courses to document their ES knowledge and whether that was important to students. The panel responded that SAP does have a certification process for students where it will provide certificates to students who have taken three courses with SAP content, but it is not SAP certification. In the opinion of the panelists, ES-related certification has less meaning in industry these days. The interview with the recruiter where students can show what they know has more effect than a piece of paper, so schools that provided ES-related certificates have stopped distributing them. On the technology side, SAP certification is just too demanding to include in the curriculum.

For example, the QUT ES program commenced giving joint certificates from SAP and QUT, and the students liked that, but with 5,000 students in ES courses, the logistics became difficult. QUT instead focused students on presenting well in their interviews and on using the output of their assignments as demonstration of their abilities. Student outputs are of industry quality for the post-graduate courses, because assignments are formulated based on realistic (if not real) tasks. The international students, however, still would like to have a certificate. Furthermore, as recruiters get used to hiring your students, they know what they can expect in terms of ERP expertise.

A key issue is measuring the extent to which students learn ES concepts. Measurement is now primarily feedback from recruiters. QUT has taken an enterprise architecture approach so that students understand the complexities and heterogeneous systems they will find in organizations that could have up to 3000 information systems.

IV. CONCLUSION

In summary, the panelists all agree that teaching with an ES is important for student learning about today's work environment. Early programmatic emphasis on developer and system integrator skills has shifted to a focus on the knowledge needed by ES users, i.e., on the skills considered necessary to use an ES to achieve organizational benefits. While teaching with an ES is well-worth doing because of the benefits to students and the companies that will employ them, developing and maintaining an ES-supported curriculum and ES-knowledgeable faculty members is a challenge. The good news is that there is now more support available to faculty members in the form of curriculum materials than ever before, and that support continues to grow.

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EDITOR'S NOTE: The following reference list contains the address of World Wide Web pages. Readers, who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

> 1. these links existed as of the date of publication but are not guaranteed to be working thereafter.

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http://www.yawl.fit.qut.edu.au/ for workflow management

http://www.bpm.fit.qut.edu.au/ for business process management

http://www.itps.fit.qut.edu.au/ for enterprise systems success

http://www.citi.qut.edu.au/members/research_areas/li/ for learning innovation projects

LIST OF ACRONYMS

ABAP	Advanced Business Application Programming – SAP's programming language
AMIS	Accounting and Management Information Systems – Department within CSUC
ARIS	Architecture of Integrated Information Systems – a process modeling software tool
ASP	Application Service Provider
APO	Advanced Planning and Optimization – module within SAP
BPS	Business Planning and Simulation
BW	Business Warehouse – the data warehouse associated with SAP
CIS	Computer Information Systems – Department within Bentley
CO	COst management or COst control – module within SAP
CRM	Customer Relationship Management
CSUC	California State University at Chico
EAI	Enterprise Application Integration

ERP	Enterprise Resource Planning
ES	Enterprise Systems
EVA	Economic Value Added – Value-based management methods
FI	FInancial accounting – module within SAP
GIS	Geographical Information Systems
G/L	General Ledger
HES	Hogeschool voor Economische Studies – School in Amsterdam
HR	Human Resources – module within SAP.
IDES	International Demonstration Education System – distributed with SAP
ISDS	Information Systems and Decision Sciences – Department within LSU
IW	Innovation Watch – SAP's curriculum repository [http://service.sap.com/iw]
LSU	Louisiana State University
MM	Materials Management – module within SAP
MRPII	Manufacturing Requirements Planning
MYOB	Mind Your Own Business – accounting software [http://myob.com].
mySAP ERP	or mySAP Business Suite – name for SAP's current product, replaces the SAP R/3 name [mySAP.com]
NSF	National Science Foundation
OAI	Oracle Academic Initiative
PP	Production Planning and Control – module within SAP
QUT	Queensland University of Technology
SAP	Systeme, Anwendungen und Produkte in der Datenverarbeitung or Systems, Applications and Products in Data Processing – a German software company
SAP R/3	one of SAP's products
SAS	originally Statistical Analysis System – a software product provided by SAS Institute
SCM	Supply Chain Management
SD	Sales and Distribution – module within SAP
SEM	Strategic Enterprise Management
UCC	University Competence Centers – SAP's university hosting sites
WPI	Worcester Polytechnic Institute

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