Communications of the Association for Information Systems

Volume 8 Article 15

February 2002

Special Issue on the AMCIS 2001 Workshops: Integrating Enterprise Systems in the University Curriculum

Michael Rosemann
Queensland University of Technology, m.rosemann@qut.edu.au

Edward E. Watson
SAP America, Edward.Watson@sap.com

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SPECIAL ISSUE ON THE AMCIS 2001 WORKSHOPS INTEGRATING ENTERPRISE SYSTEMS IN THE UNIVERSITY CURRICULUM

Michael Rosemann
School of Information Systems
Queensland University of Technology

m.rosemann@qut.edu.au

Edward Watson
Innovation Institute
SAP America

ABSTRACT

The integration of Enterprise Systems into the curriculum of Business, Engineering, and Information Technology Faculties and Schools is a major challenge for many universities. Many interesting attributes are associated with this challenge: students generally have a strong interest to learn the subject and are often biased towards product-focused materials and skills; Enterprise Systems are comprehensive and particularly complex; and practical knowledge about Enterprise Systems is often lagging. This paper provides some structure to the Enterprise Systems education issue and will help academics distinguish among different approaches for the integration of these software packages into their curriculum. Various examples will assist beginners as well as experienced academics in evaluating their efforts. The ideas in this paper were presented in a special pre-conference workshop at the 2001 annual meeting of the Americas Conference on Information Systems (AMCIS) in Boston.

KEYWORDS: Enterprise Systems, education, industry collaboration, SAP

I. CHARACTERISTICS OF ENTERPRISE SYSTEMS

Enterprise Systems (ES) can be defined as customizable integrated application software that supports the core business processes and the main administrative areas of enterprises in different industries [Rosemann, 1999]. These systems can be viewed from a variety of perspectives [Klaus et al., 2000].

- First, and most obviously, an Enterprise System is a commodity, a product in the form of computer software.
- Second, and fundamentally, Enterprise Systems can be seen as a development objective of mapping all processes and data of an enterprise into a comprehensive integrative structure.

- Third, Enterprise Systems can be seen as the key element of an infrastructure that delivers a solution to business.

The last is the perspective taken by Information Systems, and the perspective we take throughout the remainder of this paper.

As a commercial product, Enterprise Systems are offered by a range of vendors that specialize in this segment of the software market. The main ES vendors are SAP, J. D. Edwards, Oracle and PeopleSoft. Gartner Group, prior to the recession [Gartner Group, 1999], forecasted that this market will grow to more than $20 billion by 2002 - approximately half service revenue and half license revenue. They estimated that more than 90 percent of Fortune 500 enterprises purchased a module or a set of modules from an ES vendor. Gartner Group also forecast that the small and medium-sized enterprises (SME) market is the main customer group, as more than 50% of these enterprises have yet to select a next-generation ES.

ENTERPRISE SYSTEMS - TECHNICAL CHARACTERISTICS

Enterprise Systems are highly configurable to accommodate the diverse needs of users across most sectors of the economy. Enterprise Systems exist in three different forms: generic, pre-configured, and installed:

1. In its most comprehensive form, the software is *generic*, targets a range of industries, and must be configured (i.e., customized) before it can be used.
2. Packaged, *pre-configured templates* were developed for various industries (e.g., automotive, retail, oil & gas) and companies of a certain size (SME).
3. Every instantiation of an Enterprise System presents itself as the *operational installation* after the generic or pre-configured package is individualized according to the particular firm's on-site requirements.

Only in its generic state can Enterprise Systems be characterized purposefully, since any configuration creates distinct instances of the product, rendering a generic description impossible [Klaus et al., 2000]. Criteria used in this paper for characterizing the software were derived from an analysis of currently available Enterprise Systems.

Enterprise Systems are a standard software package. All standard packages targeting an anonymous market must, during the process of system deployment, be tailored to the specific requirements of the individual enterprise. However, it is not the mere fact that the software can be customized, but rather the rich potential for customizing that distinguishes ES from other packages.

Enterprise Systems are application software. The application modules of ES are integrated across the functions supported and the data involved. They are based on an underlying integrated database that stores master and transactional data in a consistent way and with controlled redundancy. The main features of Enterprise Systems are the business solutions provided, which support the core processes of the business and administrative functionality.

Comprehensive functionality is one of the main differentiators of Enterprise Systems. These systems claim to support all enterprise business functions, especially

procurement	materials management	production	logistics
maintenance	sales	distribution	financial accounting
asset management	cash management	controlling	strategic planning
quality management			

In addition to these general business functions, they often support industry specific functions like patient management in hospitals or high volume warehousing transactions for retailers.

The comprehensive functionality of Enterprise Systems requires corresponding documentation. In addition to the usual software documentation, the processes and organizational structures supported as well as the structure of the data and objects are often depicted in reference models [Rosemann, 2000a]. These conceptual models enable rapid access

to the functionality and allow navigation through different abstraction levels and between different views.

Enterprise Systems target multiple industries with very different characteristics. They can have either the ability to support different industries within one solution (e.g. coexistence of manufacturing and retailing functionality) or offer pre-configured enterprise-individual solutions.

Enterprise Systems are international. They are designed for companies that act (purchase, produce, sell, administer) in various countries. Thus, it is a prerequisite that they can handle the specific requirements of different regions. This capability includes, for example,

- pre-configured country-specific chart-of-accounts,
- pre-formatted document types like quotes, delivery notes or invoices,
- HR-related rules (e.g. payroll), and
- handling multiple currencies.

Finally, frequency and repetition of its use could be seen as an important and distinguishing feature. Enterprise Systems support recurring business processes like procurement, sales order processing or payment processes and are not focused on less structured, irregular processes like marketing, product development or project management.

In addition to integrated applications and data, a further technical characteristic of Enterprise Systems is the consistent graphical user interface (GUI) across all application areas. Thus, a user sees a single application regardless of the module he or she is working with.

Current systems are based on a three-tier client-server architecture, in which the database, the applications and the presentation form three logically independent levels. As Enterprise Systems software targets all types and sizes of companies and industries, it must handle a large volume of transactions. This technical criterion is crucial as it is often more complex to evaluate the performance (efficiency) of Enterprise Systems than its effectiveness. Current Enterprise Systems are typically 'open' regarding the possible software and hardware platforms. Most solutions run under Windows NT, various UNIX operating systems and Linux. Finally, the complexity of ES calls for adequate administration of the system. Enterprise Systems software includes user administration, database configuration, system monitoring, and performance measurement, either as part of the software or available as add-ons.

ENTERPRISE SYSTEMS – HISTORICAL PERSPECTIVE

The name was originally coined to denote enterprise-wide integrated systems in the 1980s. It was derived from the manufacturing discipline as the natural evolution of the two most popular production resource planning techniques: Material Requirements Planning (MRP) and Manufacturing Resource Planning (MRP II) [Chung and Synder, 1999; Gunmaer, 1996; Yusuf and Little, 1998]. MRP was developed to calculate materials requirements more efficiently by taking into consideration detailed manufacturing information such as product structures and routings, and manufacturing and procurement leadtimes. MRP eventually evolved into MRP II , which added new functionality like sales planning, capacity management and scheduling. Though MRP II was initially seen as the next logical step in efficient manufacturing planning, companies quickly realized that profitability and customer satisfaction are objectives that apply to the entire enterprise – extending beyond manufacturing, and encompassing finance, sales and distribution, and human resources. Davenport (1998) first drew attention to the notion that ERP was too narrow a term to denote the Enterprise-wide Integrated System and suggested, instead, that the term Enterprise Systems be used. In fact, Enterprise Systems are an evolving concept that is enriched with each new release of vendor software. The Enterprise Systems Suite (ESS) is a term that today denotes the e-Business system with ERP at its core.

Computer Integrated Manufacturing (CIM) represents a similar concept at a more micro level focusing on the design to manufacturing functions embedding at least the technical functions of the product development and production process in a comprehensive integration framework. Another aspect advanced significantly by CIM was the issue of integration. Important contributions were made especially to data and process modeling techniques.

The design of integrated and enterprise-wide data models was a major focus of CIM projects in the 80s. These projects were based on the assumption that an integrated database is the core element of an information systems infrastructure. Process modelling became the focus of attention when reference integration architectures were developed that cover more than the information flow between two functions. Entire process chains were designed in order to explain typical business processes. These models existed initially only as such, since applications to implement the design was not available yet. "Process Management was possible prior to Enterprise Systems" [Davenport, 2000]. Thus, data and integration (function) models were extended with a fast growing number of process models. In addition to the involved *business functions*, these models depicted *organizational roles*, *end-user applications* and *data*. One of the most popular methodological frameworks evolving from this research is the Architecture of Integration Information Systems (ARIS) consisting of data, function, organization, output and process views [Scheer, 2000]. Today, data and process models (referred to as reference models) are widely and effectively used to completely document business, process, information, and data models used in ERP implementation projects.

II. ENTERPRISE SYSTEMS EDUCATION: CHALLENGES AND RELATED WORK

While a significant and growing proportion of Information Systems graduates are integrally involved with the selection, implementation, operation, maintenance, support, management, development and use of software packages, Enterprise Systems as a distinct phenomenon of interest remain largely under-researched and absent in Information Management and Information Systems curricula. Paradoxically, a serious dearth of Enterprise Systems expertise exists in practice. This shortage in supply contributes to heated competition for staff with related experience, project budget-overruns, and over-reliance on external consultants and contractors.

The importance of Enterprise Systems education grew significantly in the Information Systems discipline. One indication of growth is the number of track sessions and panel discussions devoted to Enterprise Systems at key IS conferences around the world; in particular,

- International Conference on Information Systems,
- European Conference on Information Systems,
- Pacific Asia Conference on Information Systems,
- Australasian Conference on Information Systems, and
- Americas Conference on Information Systems.

A significant amount of Enterprise Systems collaboration is ongoing between faculties (and often their students) spanning multiple continents. Collaboration is most evident at the academic conferences listed and the SAP-sponsored Innovation Congress that brings together academics from around the world to present and discuss research and curriculum activities. Major IS journals published special Enterprise Systems issues in 2000 and 2001; namely, Journal of Information Technology, Information Systems Frontiers, Communications of the ACM, Journal of Decision Systems, and the Australian Accounting Review. An annotated bibliography can be found in Esteves and Pastor [2001] and Klaus et al. [2000].

Enterprise Systems education is an area demanding special attention for a number of reasons: Students have a strong interest in this subject often hoping to gain market-driven skills. While this objective often ensures record enrollment, student perceptions and expectations must be managed carefully because it is not the sole objective of ES courses to enhance student skills through training activities. Enterprise Systems are typically comprehensive and complex. The frequency of upgrades and innovations from one software release to the next characterizes the rapidly evolving nature of the systems available to business. It is often difficult for faculty to stay abreast of these changes and to understand the implications of these changes to business practice, and to research and education, in general. Hence, ES education significantly lags the real world. By the time textbooks of sufficient quality are available, there are new systems' upgrades and innovation cycles to deal with.

Enterprise Systems are used to support the learning of traditional business functions (e.g., Accounting, Finance, Operations, Marketing, Management, and Information Systems), contemporary business process analysis (e.g., Order-to-Cash, Plan-to-Produce, Procure-to-Pay), and advanced business technology (e.g., data and knowledge management, systems administration, application development, application integration). Enterprise Systems are perhaps most valuable for teaching concepts more specific to the ES (e.g., integration, implementation, and configuration) as well as emerging e-Business areas (e.g., e-Procurement, e-Commerce, Enterprise Application Integration).

Universities began quite late with the integration of Enterprise Systems-related subjects into their curriculum. An indicator of the ES curriculum integration activities in higher education is the growth of University Alliance activity between ES vendors and Universities. These alliances enabled curriculum innovations at the undergraduate and postgraduate levels often under the banner of a new program, such as the MBA program [Winter 1999], or a certain discipline, such as Information Systems Master of Science programs [Holmes and Hayen, 1999b]. Some individual experiences of universities implementing SAP R/3 into their IS curriculum were documented by Lederer-Antonucci [1999] and Watson and Schneider [1999]. Foote [1999] describes a SAP-accounting class and other SAP-related courses in the US. Shoemaker [1999] sketches a six-hour introduction to Enterprise Systems for sales and marketing professionals. Rosemann and Watson [2001] provide a tutorial on 'Teaching ERP'. Rosemann, Sedera, and Sedera [2000], Hawking and McCarthy [2000] and Rosemann et al. [2001] discuss leveraging industrial work experiences and projects for Enterprise Systems courses.

The impact of reorganizing Enterprise Systems subject matter into existing curricula and the special challenges posed to faculty were reported by Stewart et al. [1999]. The benefits and pitfalls of teaching conceptual knowledge with Enterprise Systems as a learning vehicle have been critically evaluated in terms of learning outcomes and effort by Noguera and Watson [1999] and Scott [1999]. An example of a syllabus for the remote delivery of an introductory subject via the Internet is given by Holmes and Hayen [1999a]. They describe the design of a course consisting of 10 lessons that introduce the concepts, fundamentals and framework of Enterprise Systems. Stewart and Rosemann propose increased international collaboration at universities in order to deliver ES education more cost-effectively [Stewart and Rosemann 2001].

III. ENTERPRISE SYSTEMS EDUCATION: THE WHY, THE WHAT, THE WHO, AND THE HOW

THE WHY

The obvious attraction towards Enterprise-System-enabled curriculum is to enhance learning by adopting experiential learning techniques. But also, enterprise systems help students to identify with the real world as they transfer learned concepts and principles from the classroom into real-life business practice and complexity. ES-enabled curriculum brings the classroom to life. Advocates of experiential learning are likely to be more interested in the Enterprise Systems approach.

A subtlety of this approach is that these systems require, at least, a quasi-operational database to serve as the hypothetical company. Such databases reinforce the real-world nature of this approach as they are generally based on real world environments. Hence, students are exposed to realistic datasets (e.g., product structures and routings, general ledgers, chart-of-accounts, master data attributes, and various transaction data), business and industry-specific terminology, and integration-enabled business processes and e-Business scenarios. From another perspective, students also experience the handling of mass data when they navigate through hundreds of master records in predefined model companies. Units with a focus on conceptual modelling, might find the comprehensive Enterprise Systems reference models with thousands of entity types and hundreds of process models useful. In fact, an impressive attribute of Enterprise Systems that makes them both fascinating and difficult to manage is their inherent complexity. A suite of Enterprise Systems solutions from SAP, for example, can support curricula across Accounting, Finance, Operations, Information Systems, Management, Marketing, Industrial Engineering, Engineering and Construction Management, and Computer Science. Thus, Enterprise Systems education may facilitate the teaching of complexity management.

Furthermore, a range of teaching cases provides insights into issues that can hardly be taught in a classroom environment such as Enterprise Systems implementation [e.g., Brown and Vessey, 2000]. In some cases, the implementation of an Enterprise Systems for the university administration may be used as a case study [Sieber et al., 1999; Mahrer, 1999].

Some academics raise issues about the inherent flaw in using a commercial product in the classroom. We view this argument to be naïve. We suggest that these tools should not replace traditional textbook learning approaches but rather augment them. The concepts and principles demonstrated and reinforced by the Enterprise Systems approach are product independent. As such, education in Enterprise Systems is similar to education in database management systems or CASE Tools. A difference is the richness of Enterprise Systems, which often only allows a faculy to implement and maintain one selected solution fully at a university.

THE WHAT

Approaches towards Enterprise Systems education can be characterized from a system-related viewpoint along two dimensions - the breadth of the solutions used in a program and the depth in which these solutions are covered. In addition, the approach can be differentiated by who is offering this program. For example, the depth or breadth of the educational experience increases significantly as the involved team grows from a single faculty, to a team of faculty that crosses department or college boundaries. So, although the Enterprise System can simply be viewed as a learning tool, there are a range of different uses for this tool as the later part of this section discusses.

WHICH PART OF THE ELEPHANT ARE YOU REFERRING TO?

The breadth of the system use captures how comprehensively the system is used. In the most modest form, only selected transactions (e.g. enter purchase request, run a payment process) are executed. These transactions are often not related. The advantage of this approach is that it avoids dealing with the system complexity and potential problems that would subsequently occur due to the interdependencies in the system.

The use of the system broadens as study spreads to one entire sub-module (e.g. accounts payable, cost center accounting, capacity management, sales support, payroll). More popular is the case that entire modules are utilized such as Financial Accounting, Materials Management, Productions Planning and Control. This is the dominating approach in business schools, departments, and faculties. Students are able to understand the functionality and capabilities of at least one entire (sub-)module as well as to develop an initial awareness of the integration and interdependencies within an Enterprise System.

To broaden the utilization of the Enterprise System further, experiences capture the entire core of an Enterprise System. This perspective typically includes Financial Accounting, Cost Management, Materials Management, Productions Planning and Control, and Sales. The comprehensiveness of this focus as well as the limited time with in one semester course, often requires that students only execute simple but, at least, interrelated transactions. Consequently, business process integration is the true learning objective rather than the detailed understanding of complex transactions, or the functionality and capability of the Enterprise System.

Another perspective is to discuss different industry solutions. Industry solutions can be seen as variants of the core ES solution and represent industry-specific terminology and functionality. Currently, it is still rare to find Enterprise Systems industry solutions in the University curriculum. Perhaps some contributing reasons could be the required comprehensive knowledge in the industry, the focus on one of these verticals in a unit, or the additional hardware requirements for the installation.

Currently, the interest is focused on extended Enterprise Systems, or e-Business solutions. These extensions include solutions for Customer Relationship Management, Supply Chain Management, e-Procurement, Strategic Enterprise Management, and Data Warehousing or Knowledge Management. In most cases these solutions still require the existence of an installed core Enterprise System package. These solutions have especially become popular with the increased interest in e-Business. However, until now it is still the exception to find these extensions in university curriculum for a variety of reasons

- Lack of supporting materials and curriculum, and useful datasets
- Lack of faculty possessing practical experience with these systems
- Costs to install and maintain these systems
- Lack of knowledge of the underlying theories and governing principles.

The comprehensiveness of Enterprise Systems within an enterprise suggests that Enterprise Systems education should be rather comprehensive itself. As a result, the notion that Enterprise Systems education can fit comfortably within a single discipline is perhaps not realistic. Nonetheless, Enterprise Systems education is observed primarily at the departmental level not due to requirements of the Enterprise System itself but instead due to the difficulty to implement cross-departmental, cross-college, and cross-campus initiatives at higher education institutes. While transactions, sub-modules and single modules can be taught in one unit, a focus on the entire Enterprise System solution, on industry solutions or extended Enterprise Systems requires multiple Enterprise Systems-related units and the necessary integration of these offerings. Universities that have recently begun their Enterprise Systems offerings typically teach selected transactions, sub-modules, or modules. The more experienced schools where innovation and flexibility in curriculum design is encouraged and supported can afford a more comprehensive, process-oriented view of the Enterprise System area to their students.

The second dimension along which the Enterprise System integration into the university curriculum can be distinguished is the depth of the offering. A starting point is typically to teach Enterprise System without actually providing hands-on experiences. These cases are also referred to as the 'Powerpoint-approach'. It is possible to offer a general introduction to Enterprise System and especially to discuss case studies in the context of Enterprise Systems. However, education in Enterprise System without offering hands-on experiences has its limits. As Figure 1 illustrates [Gable and Rosemann, 1999], academics regard the hands-on experience as the key to understanding the more complex and deeper Enterprise Systems and Enterprise Systems implementation concepts and issues, as well it helps students grasp what might otherwise be subtle and non-intuitive learning challenges. This research is based on an academic survey report by Gable and Rosemann and focused on the SAP R/3- enabled curricula.

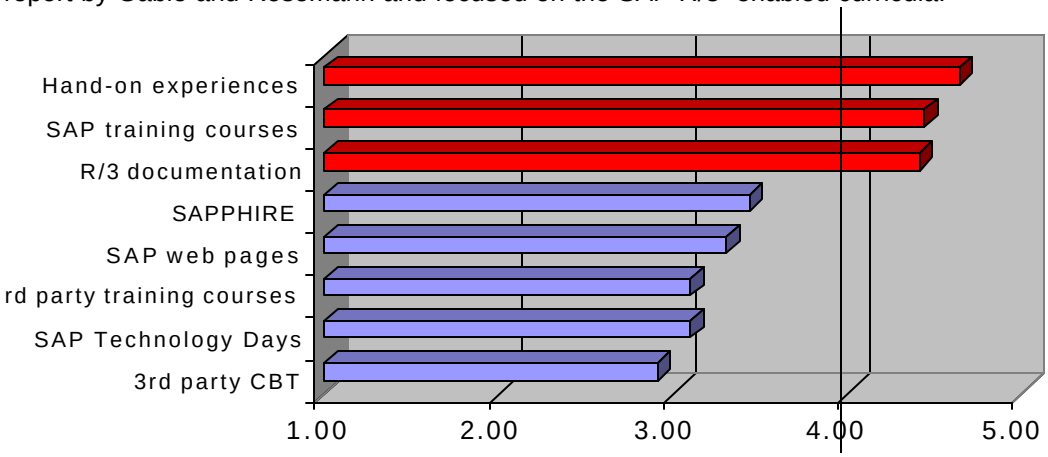

Figure 1. The Most Important Ways of Learning SAP R/3

A discussion of Enterprise Systems learning objectives and outcomes might best be prepared in the context of breadth and depth. What systems are the focus (functional, development, and technical administration)? To what depth should the experience go? Table 1 summarizes potential learning objectives.

Table 1: Learning Objectives in the Context of Enterprise Systems Education

	Learning Objectives		
Level	Functional or Process Oriented	Application Development	Technical Administration
Transaction	What is a transaction? What data is required? What is master data? What are the implications of the transaction?	How are transactions developed?	How do transactions affect system performance?
Module or Sub-Module (Academic Disciplines)	What processes does this discipline support? What is the purpose of this discipline?	How are application modules developed? How are integrated applications developed? What is it like to work in the development environment of in integrated systems?	How can system performance be optimized? What are the issues involved with setting up system security?
Enterprise	How are Enterprise Systems used to enable, or reengineer business processes? Business Process Integration	What are the database requirements for an integrated system? Workflow	How are integrated systems monitored? How are user authorizations set up in an integrated system? How is user activity traced, or audited, in an integrated system?
Cross-Enterprise	How are cross-enterprise business processes determined? What are their data requirements?	How to effectively design and build integrated applications?	What are B2B data exchange requirements and how are they defined? What B2B protocols are appropriate for different scenarios?

ENTERPRISE SYSTEMS AS A REPOSITORY

The simplest form of using an Enterprise System is just browsing through the extensive repositories that exist in the system. Most packages provide a model company, which can be regarded as a populated system including vendors, customers, materials, employees, cost objects and related transaction data. In this case students navigate through the system and gain insight into the overall structure, functionality and architecture of the system. Enterprise Systems repositories also include a vast network of interconnect process, or reference, models that identify business scenarios, process flows, events, data flow, information flows, and organizational structures. The system is often utilized as a research tool to support traditional lecture environments as well as any of the other modes (simulation, modeling, development, and administration). Other repositories the students may have access to include implementation methodology and project management tools.

Enterprise Systems as a Simulation Tool

A more insightful use of Enterprise Systems is to let students simulate transactions, entire business processes, and B2B marketplaces that are already pre-configured in the system's model company. Transaction simulation may lend itself well to lectures that focus on business process analysis, GUI design, database integrity, data level integration, and client-server architecture.

Students may simulate an entire business process such as "Procurement-2-Pay", "Order-2-Cash", or "Planning-2-Produce". Enterprise Systems support hundreds of such processes. Students find the step-by-step guideline for the execution of these processes in the web-based online-help (e.g., help.sap.com). Figure 2 gives an example for such a process based on a model maintained in SAP's Internet Demonstration and Education System (IDES). It is not required to

understand the corresponding customizing tasks, or to become involved in the system configuration but it is an option. This option is described more fully later.

Most of the existing Enterprise Systems model companies still focus on the execution of internal business processes. Therefore, a global project was recently initiated that targets the development of stable inter-enterprise business processes. The development of an Internet Marketplace simulator based on SAP's mySAP.com Internet framework is underway by a group of SAP University Alliance members [Tracy et al., 2001]. In this project each involved university represents one traditional business partner in the supply chain. Typical collaborative business processes will be configured using extended Enterprise Systems solutions. So member universities may assume a role and engage in simulated business activities within the context of a (global) marketplace exchange.

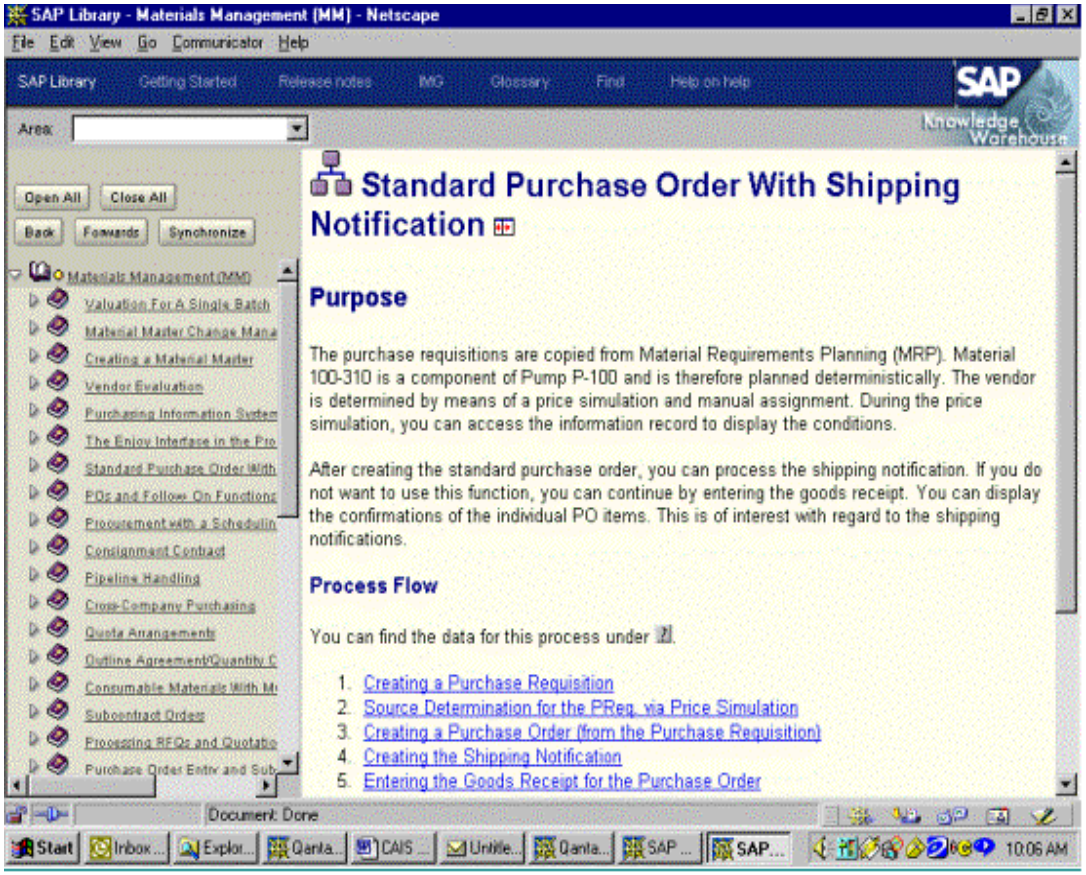

Figure 2. Example of a Business Process description from SAP's IDES

With minor modifications to the specific systems configuration, students can also be challenged to modify these pre-defined processes slightly to extend basic processes. In an introduction to Enterprise Systems at the Queensland University of Technology (QUT), Brisbane, for example, second semester students are asked to enter cost centers, revenue accounts, material master records, bill-of-materials, or employees in SAP R/3. Based on these data, an entire lecture (week 11) is spent on discussing the integration in the Enterprise System. This approach requires to a certain extent the preparation of the system in terms of configuration from the lecturers involved. Though the activities discussed to this point are for many universities at least initially challenging, the true character of Enterprise Systems can perhaps best be experienced when the configuration of the system is experienced first hand. This exercise can be simulated in a classroom environment. The authors are aware of many cases where students and

faculty are involved with systems configuration in a real implementation environment at, for instance, Universities in the U.S., Mexico, Germany, and Australia.

Enterprise Systems as an Enterprise Modeling Tool

Conceptual modeling is a core component in many Information Systems curricula. Enterprise Systems can contribute to this subject comprehensively using reference models available with SAP R/3 for example [Rosemann, 2000a]. Conceptual modeling allows discussing various modeling examples that are not only suitable alternatives to typical textbook examples (e.g. hotel, airline), but also go far beyond these examples in terms of their complexity. The reference data model of SAP R/3, for example, consists of more than 4000 entity types. Students may be engaged in activities such as browsing through these models to study integrated enabled practices, actively discussing alternative forms of configuring these models, and in modifying and extending these models. Modifications of Enterprise Systems reference models require in most cases external business modeling solutions such as the ARIS-Toolset [Davis, 2001]. Nevertheless, it is this active discussion of the available reference models and their comparison with enterprise-individual models that provides students with a true understanding of the application of these rich models.

Enterprise Systems as an Implementation Tool

Dealing with the system's configuration can be accomplished in different forms. It can start with students just browsing through and familiarizing themselves with the possible configuration tasks without actually being allowed to change the configuration. For example, in a QUT course, students have to identify the related configuration tasks for a process they executed without actually being able to change the configuration. This exercise already provides valuable insights into the structure and design of Enterprise Systems. These types of lectures are combined with an overview and discussions of various implementation methodologies and their corresponding tools. Thus, students will gain a deeper understanding into project management, requirements analysis, gap analysis and systems design.

More challenging of course is it, if students actually perform the configuration steps. Some universities offer courses on configuration management (e.g. California State University at Chico and University of South Dakota), in which students are introduced to the concept of Enterprise Systems configuration. In these courses they are often provided with a business case that they have to depict in the Enterprise System. At the University of Münster, Germany, for example, post-graduate students get the description for a retail company, which they have to represent in an Enterprise System. This case covers materials management, warehousing, sales, and accounting. In the final presentation, students have to present the execution of the entire business process across all these modules. These exercises do not always have to be that extensive. At Queensland University of Technology (Brisbane, Australia), students work on a travel management project with a local business [Rosemann, Sedera, and Sedera 2000]. The main part of the assessment is the challenge to represent the organization's requirements in a particular Enterprise System. The final project presentation covers the process including travel request, travel planning and travel expense handling.

Enterprise Systems as a Development Environment

In applications development, an ES is used for students to gain knowledge and skills working in an integrated enterprise development environment. A suite of development tools, languages, and methodologies may be used to support this sandbox environment. This approach provides students with the skill-set to implement enterprise-individual solutions that go beyond the standard capabilities of the system. Again, this can range from very simple applications that are independent from any model-company to a comprehensive project, in which students have to explore the inherent system capabilities first before they decide to what extent they have to develop further solutions. Simple configurations often take place with students who are not even aware of the system functionality, but desire to learn the Enterprise System-individual programming language as an example.

Enterprise Systems as an Administrator Environment

Students may also be engaged in a simulated Enterprise Systems administration role that provides an invaluable learning experience. Important concepts are reinforced in various key areas: user administration (e.g., security and authorizations), transport administration (e.g., moving new development from development environment to testing environment to production environment), client maintenance (e.g., managing development, testing, production, and training environments), performance monitoring (e.g., tuning work processes, system configurations and applications for optimum performance), database administration, installation support, and middleware (e.g., interfacing different systems) issues.

Conclusions on The What

In combination, breadth and depth span a vast field of possible Enterprise Systems education experiences. Together they also result in a trade-off between scope and intensity. As learning objectives are broadened or deepened, the time required to prepare and deliver the learning experience increases significantly. Thus, given a limited amount of time, an instructor must decide between breadth (e.g., comprehensive coverage of solutions that focus on, for instance, cross-functional business process integration concepts) versus depth (e.g., vertical integration in a specific discipline that focus, for example, on discipline specific concepts, business practice and IS solutions. This level of commitment often results in faculty being less willing or able to engage in this type of experience. For those who do, it is rewarding.

THE WHO

Faculty members who have an interest in Enterprise Systems, real world business practices and applications, and experiential learning most often drive alliance program success. These faculty members generally transcend the traditional role of academic faculty (i.e., research, teaching, and service) to provide students with a unique learning opportunity and themselves with a rewarding learning experience. In the initial phase of the Enterprise Systems integration, these individuals are often faced with a significant workload, which involves the Enterprise Systems selection, implementation, maintenance, curriculum development and delivery spectrum. Though this approach is very honorable, it is often not sustainable and efficient.

If multiple such faculties exist, then the utility of these systems can spread throughout a department, college or university. At Queensland University of Technology, for example, a subject called ‘Fundamentals of Enterprise Systems’ is offered collaboratively by the Faculty of Information Technology, the Faculty of Business, and the Faculty of Built Environment and Engineering. In total eight different lecturers discuss the core modules of an Enterprise System. The audience consists of undergraduate students from all three areas.

Faculty with global interests and contacts may leverage the system as a platform even for a multi-university collaboration and curriculum initiatives. An example is the collaboration between the University of Texas at Austin, the Louisiana State University and the Queensland University of Technology [Rosemann, Scott, and Watson 2000] or the award winning collaboration between Widener University and the University of Münster [Lederer-Antonucci and zur Mühlen 2001]. In both cases, students from different universities interacted directly with each other and worked in well-defined projects on ES-related issues. In a later project between the Louisiana State University and the Queensland University of Technology, students from both sides configured collaboratively one Enterprise System based on hypothetical business requirements.

A critical bottleneck for Enterprise Systems education is the actual implementation and administration of the system. Especially, if individuals are in charge for the Enterprise Systems-component in the curricula, they carry an extreme workload, which results from the ongoing system administration. An approach that allows individual academics to teach Enterprise Systems and collaborate on ES research projects without the burden of administering the system is to have the applications hosted by another university. This concept is implemented in Germany, Australia and the University States. The following section reports on the current status of this initiative using the SAP Program as an example.

IV. ENTERPRISE SYSTEMS UNIVERSITY ALLIANCE PROGRAMS

OVERVIEW

SAP is the most popular Enterprise Systems in use at universities. A worldwide survey about teaching and research related to SAP R/3 showed that most universities (outside Germany) started as early as 1997 with their initiatives in Enterprise Systems [Gable and Rosemann, 1999]. Since then, ES became an area of fast-growing interest in academia demonstrated by the continuously increasing number of courses dealing with Enterprise Systems. The international survey, for example, consolidated data about more than 180 SAP-related subjects at universities. In the US, until 1997 almost no university was teaching SAP R/3, while in 2001 more than 200 institutes of higher learning were using SAP solutions. Most of these universities report a significant increase in enrollments due to their SAP offerings. SAP's Enterprise System R/3, for example, is used worldwide by more than 450 institutes of higher learning in more than 35 countries and by more than 50,000 students.

The SAP University Alliance includes over 450 universities in its global membership. This network of faculty collectively made progress in redefining business education through the continuous redesign and delivery of their curriculum related to Enterprise Systems and E-Business.

VALUE PROPOSITION

SAP and the University jointly make an investment in the program from the beginning. The University pays a modest annual membership fee. SAP provides:

- Enterprise Systems software (ERP plus three e-Business components such as CRM, B2B, SCM, and SEM),
- access to training opportunities through SAP standard training courses and University Alliance curriculum workshops,
- technical support,
- access to the SAP University Alliance faculty network and curriculum materials,
- curriculum award opportunities,
- research funding opportunities, and
- at no additional cost, the option to be hosted by one of the University Competency Centers.

The SAP University Alliance may provide value in a number of ways:

1. *Enterprise Systems Software Donation*: Access to the Enterprise Systems Suite for use in education (curriculum) and research initiatives.

a. Option A: SAP's Enterprise Systems software and the International Demonstration and Education System (i.e., the SAP training database) will be mailed to the university. SAP also provides implementation consultants to ensure the successful software installation. Furthermore, the ongoing efforts will be supported through basis (technical) consultant.

b. Option B: Through one of its University Competency Centers (UCC), SAP provides access to SAP Enterprise Systems solutions (ERP and eBusiness). Universities also have access to a technical support hotline provided by the UCC.

c. Option C: Some combination of Option A and Option B may also be arranged.

Universities also have access to a wide range of Enterprise Systems tools and resources: application development environment and tools, Enterprise Systems implementation methodology (ASAP methodology), R/3 configuration resources and tools, SAP business blueprints and best practices (SAP Reference Models), and an extensive on-line help system that describes in detail the capabilities of the solutions. This resource is significant for students of business, engineering, and computer science.

This donation may be valued at over $1,000,000 depending on how extensively it is used.

2. SAP Standard Training: Training on the R/3 (i.e., ERP) and mySAP.com (e-Business) solutions is provided to bring faculty up to speed and to keep faculty current. Training is available based on need, availability, and potential impact on University curriculum.

3. Professional Development:

a. Curriculum Development: Particularly during SAP's Faculty Workshops, the SAP Distinguished Scholars may play the role of curriculum consultant and mentor.

b. SAP Sponsored Events: From SAP's International Innovation Congress to their SAPPHIRE Convention, faculty have an opportunity to build their academic and business professional networks.

c. Executive Education: Through SAP's executive education program, unique educational seminars and programs may be made available to members of the University Alliance.

4. Access to University Curriculum: Since 1997, SAP has funded curriculum initiatives across the country. The curriculum materials that result from these efforts are then available to University Alliance program members.

5. Curriculum Awards: Since 1995, SAP has sponsored annual curriculum awards typically valued at over $400,000 per year. This awards program is often augmented by many of SAP's key partners.

6. Research Funding: In 2001, the Innovation Institute leveraged the University Alliance program to create a research engine that matches academic research expertise to SAP corporate needs.

CENTERS FOR APPLICATION HOSTING AND ENTERPRISE SYSTEMS COMPETENCY

Some Enterprise Systems vendors introduced an application hosting concept for universities in their University Alliance program for two main reasons.

- First, a hosting center practically eliminates the required investments in infrastructure and administration as well as ongoing maintenance and upgrade efforts for a university.
- Second, an institute involved as a hosting center can serve as an important information and services intermediary between the university and the Enterprise Systems vendor.

Figure 3 provides an overview of the application hosting concept found in Australia and referred to as the University Application Hosting Center (AHC). This center is implemented within the SAP University Alliance Program. In the first step, a university interested in teaching in the area of Enterprise Systems using mySAP applications approaches the software vendor. If the proposed concept is convincing for the vendor, both parties sign a contract and the university becomes a member of the University Alliance program. This membership includes among other benefits a fixed number of training days per year. The university then gets in touch with an Application Hosting Center. The contract between AHC and the participating university includes service level agreements, fees, further educational services, and frequency and content of user meetings. The AHC expects information regarding the Enterprise Systems-related units and tutorials (content, system requirements, day and time, number of users, user rights, etc.). When a contract is signed, the university gets the required user accounts and passwords. The system can then be accessed either through a Web-based Graphical User Interface (SAP-GUI) or with lower response rate through an Internet browser. If the SAP-GUI solution is used, universities do not experience significant delays. Our own experiments in using a system based in Brisbane (Australia) but accessed from overseas showed a system response rate similar to local system use in Brisbane.

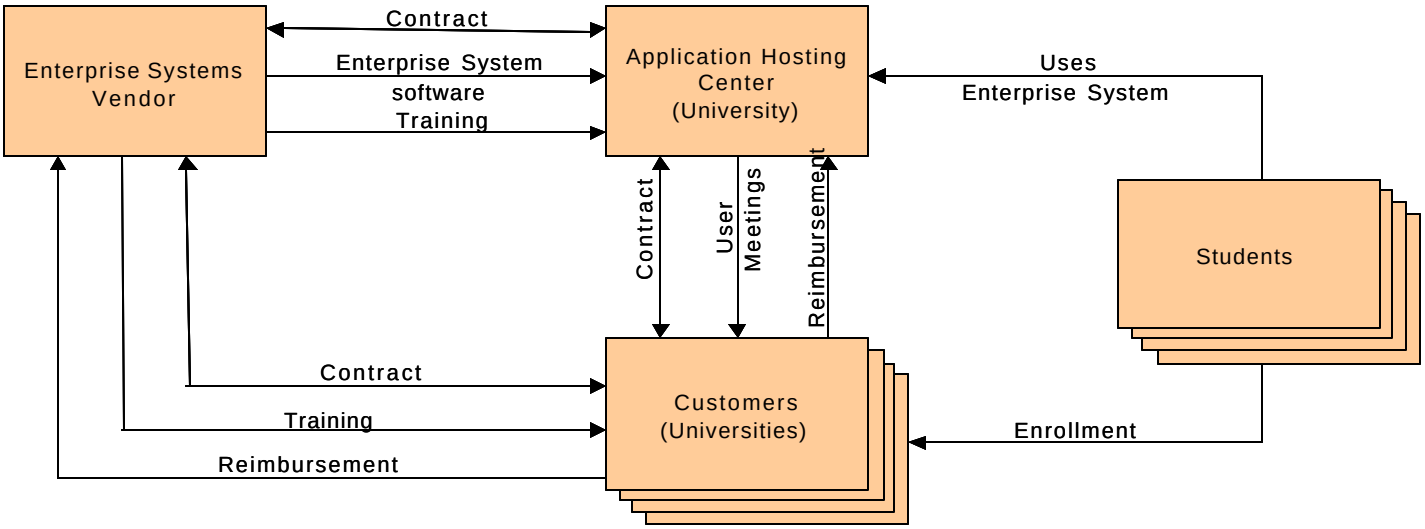

Figure 3. Interrelationships in the Australasian University Application Hosting Center

Globally, the reimbursement procedure is implemented in different ways. The university either only reimburses the AHC or it also pays the Enterprise Systems vendor a fee for Alliance membership. In any case, these fees are typically flat rates per semester or year. AHC and Enterprise Systems vendors have their own contract, which specifies services provided, key performance indicators, or the qualification level of the actual system administrators. Through this contract, the Enterprise Systems vendor tries to standardize the services and to minimize competition between AHCs in one region. An AHC typically receives further training relevant for system administrators.

By the end of 2000, Queensland University of Technology as the Australasian University Application Hosting Center (A/UAHC) received approximately 3million AUD of software and support from SAP, 1 million AUD of hardware and support from Sun Microsystems, and further administrative solutions fom realTech Australasia to establish a showcase Enterprise System service bureau in support of R&D and postgraduate training activities of Australian universities. Currently, SAP R/3 version 4.6c is installed. It is planned to implement the SAP Knowledge Warehouse, the Business Information Warehouse, and mySAP Customer Relationship Management in the near future. The A/UAHC is managed by QUT with operating costs of approximately 1 million AUD during its initial 3-year life being seed-funded by QUT and otherwise recovered through member-university annual contributions. There are currently 15 Universities in the Australasian SAP University Alliance Program. Nine of them joined the A/UAHC. Figure 3 provides an overview about the interaction in the case of the Australian University Alliance.

A similar hosting concept, referred to as the University Competency Center is now available to University Alliance schools in the United States and Mexico. Schools in Canada are investigating a simpler form of this hosting arrangement whereby sister schools may share the costs of hosting enterprise solutions.

IV. CONCLUSION

Enterprise Systems are by now an established part of many curricula in Business, IT and Engineering faculties. Because of the complex and comprehensive nature of these systems they have special requirements. This paper provided an overview about different forms of education in Enterprise Systems differentiating the breadth and depth of related efforts. This paper presents alternative forms of education related to these comprehensive systems, which can be understood as possible pathways for universities who want to expand upon their offerings over time. Possible services from the main Enterprise Systems vendors have been presented.

The current concept of hosting the Enterprise System at a university allows the convenient use of these systems as it outsources all administrative activities. This arrangement also supports the development of globally integrated curricula, which are under development in many projects. It can be expected that very soon universities will simulate e-Business scenarios collaboratively using Enterprise Systems.

Editor's Note: This article is an expansion of the authors' workshop presented at AMCIS 2001. It was received on September 5, 2001 and was accepted on November 9, 2001. The article was with the authors for approximately 9 weeks for four revisions. It was published on February 28, 2002 together with the other articles in the special issue on the AMCIS 2001 Workshops.

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ACRONYMS

AHC	-	Application Hosting Center
ARIS	-	Architecture of Integrated Information Systems
ASAP	-	Accelerated SAP
A/UAHC	-	Australasian University Application Hosting Center
AUD	-	Australian Dollar
CIM	-	Computer Integrated Manufacturing
CRM	-	Customer Relationship Management
ERP	-	Enterprise Resource Planning
ES	-	Enterprise Systems
GUI	-	Graphical User Interface
IDES	-	Internet Demonstration and Education System
IMG	-	Implementation Guide
MRP	-	Material Requirements Planning
MRP II	-	Manufacturing Resource Planning
SCM	-	Supply Chain Management
SEM	-	Strategic Enterprise Management
SME	-	Small and Medium-sized Enterprises

ABOUT THE AUTHORS

Michael Rosemann is Associate Professor of Information Systems at the Queensland University of Technology. He is author of 2 books, editor of 2 books, and published more than 70 journal and conference articles. Besides Enterprise Systems, he is interested in process and workflow management, conceptual modeling, operations management, and distance education. Dr. Rosemann became involved in Enterprise Systems education in 1993.

Ed Watson is the Program Manager for the SAP University Alliance in the U.S. Previously, Dr. Watson was Associate Professor of Information Systems and Decision Sciences at Louisiana State University. His publications appear in *Communications of the AIS*, *Decision Sciences*, *European Journal of Operations Research, IEEE Transactions on Computing, International Journal of Production Research*, *Interfaces*, *Quality Engineering*, and *Decision Support Systems*.

Communications of the Association for Information Systems

ISSN: 1529-3181