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Abstract

This paper presents and discusses the design of a problem based learning approach that seeks to embed industrial knowledge in the curriculum. It describes a project currently underway that is developing a business reference model using Process Engineering techniques. This reference model is being implemented in the leading Enterprise-wide System (also known as Enterprise Resource Planning System) SAP R/3.

Teaching cases are being developed through collaboration between universities and industry. These teaching cases are to be available for use in the IS curriculum, irrespective of which faculty in which this curriculum is found. The teaching cases will also be available for wide distribution.

This paper argues that this approach is in alignment with the recommendations of key curriculum documents and educational approaches. It also argues that the resultant teaching cases will be attractive to students, meet the current requirements of industry while maintaining the focus on education and the fundamentals of the IS Curriculum. This paper is the result of collaborative activity of two Australian Universities and one American University seeking to develop appropriate curriculum material and working collaboratively with other universities.

Introduction

There is a need to develop IT students that have business knowledge, and business students that have IT knowledge (Microsoft Press 1998, Gartner Group 1998). There have been a number of efforts to link academic study towards industry needs. Professional societies have defined a body of requisite IT knowledge (ACS Core Body of Knowledge 1997) and have called for increased relevance of IT education (British Computer Society 1999, IEEE 1999, ACM 1997, 1999). These activities have led to various the formation of collaborative curriculum committees to address this issue (IS'97, IS'2000, ISCC 99).

The Information Systems-Centric Curriculum Document (1999) was the output of a collaborative review process held in the USA, with industry and academic participation. This curriculum committee sought to identify the skills required in developing and supporting large and complex systems in use within government, industry and defence. It recommends that students should undertake IT curriculum which has students experience and analyse real application systems from the beginning of their course (AMCIS Proceedings 1999: 204). This requires students to have exposure to a real and functioning application system. The ISCC committee identified the skills required for industry, and these are shown in Table 1.

Table 1 Skills of an Industry Ready IT Graduate (Information Systems Centric Curriculum)

INDUSTRY-DEFINED ATTRIBUTES OF AN ISCC'99 GRADUATE		
Personal Skills	Systemic-thinking skills Problem-solving skills Critical-thinking skills Risk-taking skills	Personal-discipline skills Persistence Curiosity
Interpersonal Skills	Collaborative skills Conflict resolution skills	Communication skills (oral, written, listening, and group)
Technical Knowledge and Skills	Information abstraction, representation, and organization Enterprise computing architectures and delivery systems Concepts of information and systems distribution Human behavior and computer interaction	Dynamics of change Process management and systems development Information Systems domain knowledge Use of computing tools to apply knowledge

The ISCC 99 curriculum document also recommends that an inverted curriculum model be used. In this approach, the student experiences the context of the information system, then master the details and finally returns to a systems view of the deployment of the technology in order to complete their experience.

Over the last several years, a number of universities internationally have been using Enterprise-wide Software (SAP R/3, BaanERP, PeopleSoft, Oracle Financials, OneWorld) as a means of providing access to these functioning application systems. Numerous IS conferences have had mini-tracks directly addressing this adoption of ERP into the curriculum (AMCIS Milwaukee 1999, AMCIS Long Beach 2000, DSI Athens 1999, DSI New Orleans 1999, ECIS Kopenhavn 1999, ACIS Sydney 1998, ICIS Helsinki 1998).

Hawking (1999) gives a review of activities in Australian Universities, and shows how such curriculum addresses the IS'97 curriculum. Stewart and Rosemann (1999) argue that the development of effective curriculum that exercises the full range of SAP R/3 functionality is beyond the capacity of any single university, and thus there is a need for collaborative effort between universities in order to address the current needs. Other researchers have argued both for and against the use of Enterprise-wide systems within the curriculum (Gable, et al 1998, Murphy et al, 1999).

We propose in this paper, how to develop such an inverted curriculum model for use through the IT curriculum, irrespective of where that curriculum is found (in Schools of Business, Information Technology, Science or Engineering).

We discuss a project in which we are developing a fully functioning business application system that demonstrates the full range of business processes found in a typical food processing industry. We have targeted the food processing industry because it is a universal industry - every local economy has some element of this industry in close proximity to the university. This industry sector can also provide experience in supply chain management, customer relationship management, virtual market places and electronic commerce. The food processing industry has a simplified supply chain. It draws heavily on the local industry and infrastructure. Despite the localisation of industry production, the food process industry can also be an active participant in the virtual electronic market place. Thus, a detailed study of this the use of information systems and information technology within this industry sector has the potential to provide a rich set of teaching cases.

Other environments also meet these requirements of a simple supply chain and pervasive penetration in regional economies. One such environment is health care. This is a considerable expense for most economies, and a target for more effective management using case management strategies while dealing with the complexities of diverse patient records and humane care. There are over sixty commercial products available for health management including systems from McDonnell Douglas, PeopleSoft and SAP. Every region has a local hospital, and thus this environment also is attractive to model as there is a well defined simple supply chain, best practice models and rich research results from the work in Health Informatics.

We next describe the project and show how its design addresses the goals of problem based learning. We then argue for the need for collaboration between universities. We close by examining the project deliverables.

Defining the Project

In this section, we describe the project, define its objectives, and discuss its deliverables and outcomes.

We propose to develop an enterprise-wide business process model of an actual business within the food processing industry. This industry has a simple supply chain, and thus students will be able to experience the functionality of all aspects of a business: procurement, manufacturing, inventory control, sales and distribution and managerial accounting. This model will be designed by students within a new subject called Projects in Process Engineering. Organised like a consulting project, the participating students will have to plan the project and conduct interviews in order to design as-is and to-be process models. Organisational and IT opportunities and constraints will have to taken into account. The completed business process model will serve as a business blueprint for further subjects and the universities. Students will have to configure SAP R/3 based on the specified requirements.

We propose to use SAP R/3 because it supports over 800 common business processes, and offers models of best practice. Consequently, it will be one task to compare the source company's model with the reference model developed by the project teams. From this model, we propose to develop courseware that specifically addresses the industry requirements in ERP related experience, and then extend this throughout the IT curriculum. Thus, this business process model will serve as a specification of a model company and is an alternative to the somewhat restricted model (IDES) developed by SAP.

Note that this approach uses SAP R/3 as the tool for developing and implementing the business process model. Though the students do gain useful skills in intensely interacting with the product, teaching SAP is NOT an objective of the program. The learning activities of process modeling, configuration and customisation of R/3 are focused on achieving the higher level learning objectives of analysis, design, integration and synthesis.

We have secured seed funding of AUD150, 000 over two years for the development of this process model. We have teams of graduate students currently working in one government agency to develop process models. We are awaiting the availability of staff in the targeted food-processing firm. This firm has significant IT projects underway, and is not available to participate until the next financial year.

This fully functional application system will allow students to understand common business functions and appreciate a process view of organisations. This application system will provide the context for all subsequent systems development within the IT curriculum, where students learn to extend system functionality through developing additional specialist systems, or seek to extend the basic system with enhanced reports and screens. Students will be able to study the process and component models inherent in the application, thus having real-world representations for database design. Students can also analyse the network and computer systems design, to apprehend the application of theory to practice in these domains. Students can participate in the modeling exercises leading to the creation of the business model, thus gaining skills in Process Engineering. In addition, teaching cases can be developed that encourage the perspective that technical solutions should meet business needs, and address the wider sociological aspects that such interventions impose on organisations. Since we will implement the model in the world's leading Enterprise-wide System (SAP R/3), we will be addressing critical skills shortages in this area.

This industry-based business process model and fully implemented working information system will provide a common platform for lecturers in specialist areas to develop problem based learning experiences. There will be an integration of knowledge across disciplines, as students (and lecturers) incrementally gain exposure to differing aspects of an Enterprise-wide System. This leads to a deeper understanding of organisational processes and the links of technology with those business processes. This provides for the development of an integrated view of the discipline, and closer coupling with industry needs. The orientation of curriculum towards problem based learning is a paradigm shift for many lecturers, from content mastery to applying theory to practice and from oracle to learning facilitator.

Bentley et al (1999) and Ellis et al (1998) believe that problem based learning is well suited to the teaching of Information Systems. What is required is a set of realistic application systems that represent organisations structures and functions, and that require extending in functionality. We believe that this reference model, and its implementation, provides the basis for the development of problem based learning modules.

The use of a real industry model spanning organisational functions has the potential to integrate studies in information technology, business and engineering, and facilitates the acquisition of technical IT skills in a realistic setting. It facilitates a deeper understanding of business processes that Information Systems students develop and support, and provides the technology environment that network specialists and computer scientists design and support. Finally, new products developed for SAP are specifically addressing the emerging virtual market place through electronic commerce (Supply Chain Management, Business-to-Business procurement, Internet-based marketplace through mySAP.com).

The development of a functioning business model that exercises the full supply chain increases students knowledge of the issues involved in supply chain management, customer relation management and the need to integrate diverse applications to support business-to-business (B2B), and business-to-consumer (B2C) computing. This ERP platform, through SAP R/3, provides the integrative environment that links technology, business, and strategy. It is only through such an integrated enterprise model, that students can appreciate the technical solutions to business problems. Furthermore, they will learn key consulting skills within the design of the business process model.

The grounding of skill development in such a rich and commercially aware environment allows for greater student understanding and immediate application in the employment market, thus addressing a criticism being currently leveled at university technology and business education. Thus, the development and implementation of curriculum utilising this Enterprise Wide System forms the basis of sustained change in curriculum design. The implementation of problem based learning experiences is the basis of sustained change in curriculum delivery, and provides tight coupling with industry needs.

Teaching cases will be designed to orient IT students to business application development, and to orient business students towards exploiting IT for strategic gain. We expect that the development of the implemented business model and associated teaching material will lead to more universities seeking to integrate R/3 experience into their IT, business and manufacturing engineering curricula. This proposal is also a vehicle to provide a platform for integrated IT, business and manufacturing engineering studies. This model and associated teaching and learning resources will not only help to address the paucity of curriculum materials for the Alliance Universities but will make the newly developed curriculum materials accessible to all universities and TAFE colleges throughout Australia.

The need for collaborative development

The development of such a model in the business world costs tens of millions of dollars, as the system needs significant consulting effort to integrate into a real organisation. The modeling exercise is costly, and beyond the funds of a single university. The model of collaborative curriculum development (Stewart and Rosemann 1999) seeks to forge links between university academics throughout the SAP University alliance, thus reducing curriculum development costs while increasing quality and penetration of appropriate curriculum.

There is a real opportunity for effective collaborations between universities in developing this rich teaching case base, if we can work across the supply chain. For example, one university may have the support of the manufacturer of the central product line, another university may be able to work with the distribution channels and transport companies that actually distribute the product, and yet a third university may be ideally placed to work directly with the raw ingredient providers. This means of interaction then provides realistic problems for the students of these universities, generates meaningful research and consultancy links with the targeted industry sector in the supply chain, and localises activities. This relationship is a win-win, as would also be those universities that seek to collaborate on developing best-practice process models for specific functions within the core industry. For example, it is possible for universities specialising in inventory control systems to collaborate to find better inventory control systems for the specific food processing industry.

Progress to Date

We were unable to commence modeling the targeted food industry partner because they have been too busy with implementing a Goods and Services Tax and upgrading to SAP R/3 version 4.6. We will commence working with the food industry partner commencing in July 2000.

Instead, in this first phase of the project, we have had four teams of four graduate students each work with a government agency that is the SAP R/3 implementation partner for smaller government agencies. These teams have been assigned one critical business process each and are seeking to model that process in such a way that the agency can demonstrate the clear achievement of business benefit from the adoption of SAP. These teams have completed the as-is model, the to-be model and are now engaged in the process configuration studies. This project has had the endorsement and the active involvement of the Group Managing Director, and senior directors of the agency. In addition, SAP consultants from PriceWaterhouseCoopers and SAP Consulting (Australia) have been involved in critiquing the students' work.

Next semester we will assign teams to work in the food industry. In addition, we will be working with a Military Hospital in developing a process model that will be used in refining a Hospital Administration System. This latter system will implement the Clinical Care Pathways model and is focused on tracking the patient from the first point of contact. The issues of systems integration from disparate functional information systems is factor in this project. These systems include a financial system (using SAP R/3), a personnel management system (using Peoplesoft), logistic systems (Mincom's Mims), tracking systems making payments to external health care providers and various corporate systems that aggregate medical data for corporate reporting.

Conclusion

This paper described an innovative project, which has two key outputs. The first output is the development of a reference model for the full supply chain of an industry (food processing, Health Care and the Service Sector). The second output is its subsequent implementation in the leading Enterprise-wide Software System SAP R/3.

The paper showed how teaching cases will be developed for use throughout the IS curriculum, based on these outputs. These teaching cases will utilise a problem based learning approach in order to implement key recommendations of the ISCC 99 curriculum document - the use of an inverted curriculum model. The teachings cases will be written to allow the student experiences the context of the information system, then master the details and finally returns to a systems view of the deployment of the technology in order to complete their experience.

The reference model development is currently underway. Additional funding is sought to fully implement the model in SAP R/3 and to develop teaching cases based on the reference model.

This project is an extension of a very successful industry-university partnership, and breaks new ground in developing industry specific solutions, industry specific deep knowledge within the student body, and generic desired skills. The development of the process model, its implementation and the development of associated curriculum resources is novel within Australia. The sharing of these resources with the members of the SAP-University Alliance is novel. This project is also a model for curriculum collaboration between Universities, encouraging joint development where appropriate, while sustaining competition in the national interest.

This collaboration of Software Vendors, Hardware Vendors, IT and Management Consultants and Universities is unique, and possibly a worlds first in developing industry relevant IT curriculum. The output of this collaboration will meet the teaching objectives of the Information Systems-Centric Curriculum Model, and permit the local development of problem based learning exercises for all Australian Universities. This model of collaborative curriculum development forges long term links between industry and university, and between universities. We expect this model will continue to operate after the grant has delivered the initial products, because it will demonstrate benefits to all parties.

There is an opportunity to develop closer collaboration between universities in developing this rich case base. Universities with interests along the supply chain can comfortably afford to collaborate, yet maintain their competitive advantage in their area of specialisation. Universities can collaborate in their intersections of

specialisation, to develop best-practice models for industry, thus achieving commercial advantage, as well as stimulating research and other consulting opportunities.

We invite participants at the conference to approach us about being full and active collaborative partners in these projects.

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