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An Innovative Framework of Integrating ERP into IS 2010 Model Curriculum

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ABSTRACT
The wide spread of Enterprise Resource Planning (ERP) technology has made information systems (IS) education shift the focus from functional applications development to enterprise software implementation and configuration. The latest model curriculum for undergraduate IS programs, the IS 2010, has made teaching the large and complex ERP software system an important issue. This paper presents a framework of innovatively integrating ERP into four core and three elective courses proposed in IS 2010. The paper illustrates the integrated ERP curriculum by discussing the design, content, and teaching methods for the seven courses using SAP as the software tool. The purpose of the paper is to provide a useful guideline for those who seek to teach ERP technology in the undergraduate IS curriculum.

INTRODUCTION
Information systems (IS) education is being transformed from the development of functional applications towards the implementation and configuration of integrated enterprise software—enterprise resource planning (ERP) (Topi et al., 2010). The trend is reflected by the significant changes made on the IS cores and electives in the latest model curriculum, the IS 2010 Curriculum Guidelines (Topi et al, 2010). In the core, this new model removed application development and replaced it with enterprise architecture. The model also recommended that enterprise systems be added as an elective course to teach technical ERP implementation and configuration.

ERP systems are generic and packaged software systems that provide comprehensive functionality and business process integration across the enterprise. ERP is a platform that integrates all business functions with its centralized data repository shared by all the business processes in the integrated enterprise-wide system. Unlike other computer applications, ERP has the multidisciplinary scope of enterprise system concepts that requires internal cross-disciplinary coordination (Anderson, Nilson, & Rhodes, 2009). Learners must acquire and understand cross functional processes while implementing and configuring the ERP software. Therefore, instead of teaching ERP in a single IS course, an effective IS curriculum should integrate ERP in multiple IS courses with focus on different but integrated topics to reflect the complex reality of
ERP implementation and configuration. This paper presents a framework of innovatively integrating ERP into multiple core and elective courses proposed in IS 2010. The framework will help IS educators design an effective curriculum to teach students with in-depth ERP knowledge and extensive ERP skills.

FRAMEWORK

ERP systems have been taught in the academic world for more than a decade. Many research initiatives have been undertaken to better understand the skill requirements of ERP graduates (Becerra-Fernandez et al. 2000; Boyle and Strong 2006; Watson and Schneider 1999) and how to integrate ERP into business or engineering curriculum (Boykin & Martz, 2004; Davis & Comeau, 2004; Johnson, Lorents, Morgan, & Ozmun, 2004; Peslak 2005; Seethamraju, 2002). However, very little has been done to integrate ERP into the model IS curricula such as IS 2010.

Pedagogical methodologies such as hands-on experience, case teaching, technical implementation and simulation approaches are highly valued in the current ERP education. Hands-on experience enables students to navigate, explore, process transactions and configure ERP systems. But the laboratory manuals often focus on step by step instruction, not on business logic (Scott & Sugar, 2004). Consequently, students learn to execute ERP technical tasks without understanding why they are being performed. Hands-on learning experience has limited value unless it is reinforced with in-class discussion and review. The integration of hands-on laboratory learning and business process learning via reading, discussion, and case study is a challenging approach to learning ERP fundamentals.

Some SAP educators have responded to the challenges by using case teaching to recreate the organizational context within which ERP implementations are conducted. The case teaching approach usually achieves in more process-oriented thinking than traditional or functional teaching approach does. This approach allows students to develop high-order reasoning skills with hands-on experience (Fedorowicz, Gelinas, Usoff, & Hachey, 2004; Hackney, McMaster, & Harris, 2007), which in turn increases their motivation and interest in the subject. But these teaching cases rarely allow students to experience all the challenges of the whole process of changing business processes, as they do not give students the opportunity to interact with professionals and face the problems in the real world (Morrell, Freeman, Serrano, & Mock, 1993).

To maximize the learning outcomes, some ERP educators use the case teaching method and simulation software tools. The case teaching methods result in more process-oriented thinking than traditional functional area education. The ERP simulation environment allows students to develop higher order reasoning and decision making skills and increases their learning motivation in ERP. But simulation is inevitably somewhat artificial.

Most ERP educators limit the scope of their ERP teaching to technical implementation and configuration issues in a single course, rather than addressing more strategic issues tied to the adoption and use of the systems in the overall IS curriculum. Recognizing this curriculum design limitation, this paper presents a framework to innovatively integrate ERP into a variety of IS
cores and elective courses at different levels. As illustrated in Table 1, the framework integrates the ERP into four cores and three electives of the model curriculum IS 2010.

Because ERP hands-on activities need to be conducted in all the courses in the framework, SAP is utilized as the ERP software tool in the framework. Introduction of each ERP topic can be followed by a set of SAP hands-on lab modules, teaching cases or simulation tools. All the teaching resources can be downloaded from the SAP University Alliance (UA) Curriculum Innovation Web site for UA members. The remainder of the paper will discuss how to integrate ERP into these seven courses.

Table 1: Framework of Teaching ERP in IS 2010 Model Curriculum.

<table>
<thead>
<tr>
<th>IS 2010 Curriculum Courses</th>
<th>ERP Course Content</th>
<th>Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core: IS 2010.1</strong>&lt;br&gt;Foundations of Information Systems</td>
<td>ERP interface navigation&lt;br&gt;ERP system capabilities exploration&lt;br&gt;ERP e-collaboration exploration</td>
<td>ERP Lab Modules</td>
</tr>
<tr>
<td><strong>Core: IS 2010.2</strong>&lt;br&gt;Data and Information Management</td>
<td>ERP data design, reuse and integration&lt;br&gt;ERP data warehouse &amp; intelligence</td>
<td>ERP Lab Modules</td>
</tr>
<tr>
<td><strong>Core: IS 2010.3</strong>&lt;br&gt;Enterprise Architecture</td>
<td>ERP infrastructure and components&lt;br&gt;ERP fundamentals</td>
<td>ERP Lab Modules</td>
</tr>
<tr>
<td><strong>Core: IS 2010.6</strong>&lt;br&gt;Systems Analysis &amp; Design</td>
<td>ERP business processes diagrams&lt;br&gt;ERP implementation methodology</td>
<td>ERP Lab Modules</td>
</tr>
<tr>
<td><strong>Elective: IS 2010</strong>&lt;br&gt;Business Process Management, Enterprise Systems</td>
<td>Business processes integration&lt;br&gt;ERP simulation game</td>
<td>Simulation software</td>
</tr>
<tr>
<td><strong>Elective: IS 2010</strong>&lt;br&gt;Enterprise Systems</td>
<td>Business process reengineering (BPR)&lt;br&gt;ERP System configuration</td>
<td>Hands-on case manual</td>
</tr>
<tr>
<td><strong>Elective: IS 2010</strong>&lt;br&gt;Application Development</td>
<td>ABAP development workbench&lt;br&gt;NetWeaver programming</td>
<td>Hands-on case manual</td>
</tr>
</tbody>
</table>

**Core 2010.1: Foundations of Information Systems**

IS 2010.1, Foundations of Information Systems, is a core course designed to provide students with a fundamental understanding of IS knowledge and skills. Hands-on exercises such as ERP interface navigation and system exploration can be integrated into this course to assist students in understanding the capability and functionality of integrated information systems with inter-organizational partners. Figure 1 shows the design of this course with ERP content.
SAP interface navigation, for example, starts with log-on to SAP, creation of multiple sessions, and use of the title bar, menu bar, status bar, command field, functions of different icons and help. SAP exploration focuses on supply-chain management (SCM), customer relationship management (CRM), and supplier relationship management (SRM) and project product lifecycle management (PLM) sub-systems. In order to help students learn the actual use of the SAP system to facilitate business processes, purchase order process and sales order process can be used as example exercises. In addition, students can be introduced to the e-collaboration environment through SAP NetWeaver exploration.

**Core 2010.2: Data & Information Management**

In IS 2010.2, Data & Information Management, enterprise data modeling and business intelligence are introduced. The enterprise data modeling shows the overall picture of the organizational data employed in many different departments, whereas enterprise systems are database applications that provide necessary data for the enterprise business processes. As shown in Figure 2, in this course students will learn enterprise data modeling for ERP and the two business intelligence report functionalities: OLTP and OLAP.
Enterprise data modeling can be top-down or bottom-up. In ERP data modeling, more bottom-up approaches are used for re-engineering and immigrating data from existing systems. Business functions with their master data stores can be used for either top-down or bottom-up approaches during the customization of ERP to the organization business processes. Master data stores are used more frequently than the other types of data across ERP systems in both operational systems and analytical systems. Enterprise modeling is to ensure that all applications that use these master data stores.

Data in SAP can be classified into four categories. Organizational data are used to represent the structure of an enterprise include client, company and plant data. Master data represent entities associated with the business processes such as buying materials from vendors and selling materials to customers. Situational data are specific to the task being executed, such as who, what and where. Transactional data are combination of organizational data, master data and situational data. Transactional data reflect the consequences of process execution.

ERP provides two report options: online transaction processing (OLTP) and analytical analysis processing (OLAP). OLTP generates reports based on transaction data in ERP databases. OLAP generates detailed reports using dedicated analytical tools based on aggregated data in information structure. Each information structure has characteristics, key figures and period definition.

More powerful ERP reporting capability is provided in business intelligence. SAP business warehouse (BW) provides users with powerful analytical capabilities known as business intelligence that collect and analyze operational data from a variety of sources for decision making. SAP BW is a separate system that receives data from the SAP system. Unlike the OLAP environment in SAP, SAP BW is not a real time system. Data in SAP BW reports are not tied to SAP real-time transactions and they can be imported from SAP databases, other external databases or XML data files.

**Core 2010.3: Enterprise Architecture**

Enterprise Architecture is the course that explores organizational structure and the design, selection, implementation, and management of enterprise architecture and its components. As shown in Figure 3, integrating ERP software into the course can help students visualize the organizational structure and enterprise architecture.
Each organizational has an organizational structure. The organizational elements stay the same whether the SAP system is being implemented for manufacturing or service related industry.

SAP infrastructure is consisted of application modules that are accomplished via a very comprehensive set of business process procedures (BPPs). Major business processes are composed of application modules in four categories: Financial management application, logistic, human resources, and the workflow and industry solutions, known as the common systems. Each application module is a collection of a number of related business process procedures (BPPs). Business processes and business functionality found in the organization are built with these application modules and BPPs. SAP database tables and ABAP application code in BPP can be revealed to students in the course.

**Core 2010.6: Systems Analysis & Design**

Systems Analysis & Design is the course that covers a systematic methodology for analyzing business requirements and specifying the requirements for ERP systems. As indicated in Figure 4, students will learn ERP business process modeling using Accelerated SAP (ASAP) and business process diagrams in this course.
Accelerated SAP (ASAP) is a system development life cycle (SDLC) methodology that has been created to guide the rapid implementation of the SAP Enterprise System. It is a computer systems analysis and design methodology and tools provided by SAP AG. This methodology seeks to standardize and expedite the typical SAP implementation and has been proven to be effective across industries and different customer environments. In practice, ASAP makes it easier to assign consulting tasks among different projects effectively and to provide an increased level of consistency.

In SAP, the development life cycle is consisted of the following five phases:
- Project preparation defines the project’s scope and organizes the team, vendors and hardware.
- Business blueprint defines business process requirements and discusses configuration and data migration.
- Realization configures the system, writes middleware interfaces and develops ABAP code.
- Final preparation includes testing and training.
- Go Live begins using the system.

Business process modeling is a set of communication means that can be utilized by the SAP team members in the blueprint phase. BPMN is the standard way of modeling and documenting business processes in most organizations. The other two types of commonly used graphical representations, the deployment flowchart diagram (DFD) and event process chain (EPC) diagram, can also be used for graphical illustration of the business processes. In this course students will learn how to create BPMN, DFD and EPC diagrams.

Landscaping is the environment where ERP customization activities of configuration are actually performed, tested and released to production. Configuration activities take place in the development system. The development system includes customizing client, testing client unit, sandboxing (prototyping) client and developing customer processes. SAP recommends that ERP users set up the development system, the quality testing system, and then the production system. Each change made to the system, such as software upgrades and releases, can be tested fully before being released into production. The transport directory is the mechanism to load and test these changes.

**Elective: Business Process Management**

This elective course introduces ERP strategic and managerial issues. Students will learn key concepts and approaches to business process management and implementation (see Figure 5).
A business process is a set of logically related tasks performed to achieve defined business outcomes. The SAP ERPsim simulation game will provide the ERP environment for students to experience an integrated business process enterprise system. Students can be divided into teams. Each team will operate a make-to-stock manufacturing plant that interacts with the suppliers and customers by sending and receiving orders, delivering their products and completing the whole cash-to-cash cycle. Students will get the opportunity to make strategic decisions for product design, sale forecasts, production improvements and timing of production release.

At the end of the game, raw materials and finished goods inventory will be sold out at a reduced price. Team members may renegotiate their bank loan with the bank at the end of each quarter. Interest is calculated quarterly and will be charged automatically at the end of a quarter. The company (team) displaying the highest equity value (shareholder capital) at the end of the simulation wins the game.

As a make-to-stock manufacturing company, there are four of processes that must be performed (i) the planning process, (ii) the procurement process, (iii) the production process, and (iv) the sales process. Each process can be decomposed into transactions. To complete the four operational processes mentioned above, a total of fourteen transactions must be performed. Most of the transactions involved in these processes are operational in nature, such as to purchase materials or to deliver finished products (Léger, Robert, Babin, Pellerin, & Wagner, 2007).

**Elective: Enterprise Systems**

This elective course teaches advanced ERP business process re-engineering and system configuration. Students will learn how to reengineer business processes, map them into SAP R/3 and configure a simple workable integrated enterprise system. Based on the specific organization requirements, students would create an enterprise structure and relevant master data for SAP system configuration.

Business process reengineering (BPR) is the basis for ERP system configuration. BPR is the analysis and design of workflows and processes within an organization. BPR transforms organization operations to entirely new, more effective business processes. There are numerous
BPR approaches, and they each differ according to the magnitude of the change and the change effort involved. IS educators must select a model that fits their need in this course to teach BPR.

Figure 6: Course Design of Enterprise Systems.

The Implementation Guide (IMG) is a SAP system tool for configuring the R/3 System to meet a company’s requirements. The SAP IMG is an integral part of the R/3 system that is used in the configuration of the R/3 system. About 80 percent of a typical SAP system installation is handled by the IMG configuration setting. Another 10 percent are enhancement of ABAP tools and appended structure, while 10 percent are customer developed via ABAP tools. A project IMG is a subset of the Reference IMG that contains the documentation for selected IMG components that are implemented as part of the specific configuration project.

Elective: Application Development

This elective course is designed to introduce ERP application development using either advanced business application programming (ABAP) development workbench or NetWeaver programming in the application development course (see Figure 7). Students learn the design and development of more specific and customized ERP functionalities for the enterprise system.

Figure 7: Course Design of Application Development.
The ABAP Development Workbench is an integrated set of fourth-generation tools, which support the implementation of critical client/server applications, or add-ons to standard R/3 System modules. This is where customer developed processes takes place. This toolset is especially suited to R/3 System installations that require enhancements to standard R/3 business applications with customized add-on functionality. The major components of the ABAP Development Workbench include ABAP Programming Language, ABAP Dictionary, ABAP Editor, ABAP Function Library, Data Modeler and R/3 Repository.

SAP NetWeaver is the Internet enabled technical foundation for all SAP applications as shown in Figure 20. SAP NetWeaver provides the development and runtime environment for SAP applications and can be used for custom development and integration with other applications and systems. SAP NetWeaver is built using open standards and can be developed with, and interoperate with, Microsoft .NET, Sun Java EE, and IBM WebSphere. Either the Java, ABAP or .NET language can be taught for the enterprise portal development on SAP NetWeaver in the Application Development course.

**SUMMARY**

The framework described in this paper integrates ERP into four core courses and three elective courses proposed in IS 2010. Fundamental ERP concepts and skills can be introduced in Enterprise Architecture, Foundations of Information Systems, Data and Information Management, and Systems Analysis & Design. Advanced and intensive ERP topics can be taught in Business Process Management, Enterprise Systems and Application Development. In summary, these seven courses cover a spectrum of cohesive and interrelated ERP learning elements:

- **Foundation of Information Systems** - introduces basic ERP concepts and provides hands-on experience on ERP system navigation and exploration.
- Enterprise Architecture - introduces ERP infrastructure at a conceptual level.
- **Enterprise Systems** - introduces ERP technical implementation and configuration.
- **Data and Information Management** - introduces enterprise data structure in ERP systems and ERP data warehouse for business intelligence.
- **System Analysis and Design** - introduces ERP development methodology and environment as a viable alternative to system development.
- **Business Processes Management** - covers ERP strategic and managerial issues and in-depth integration and implementation of business processes.
- **Enterprise Systems** - covers advanced ERP business process through system re-engineering and configuration.
- **Application Development** - covers advanced ERP applications development via either ABAP Development Workbench or the Web Portal on the SAP NetWeaver.

The combination of hands-on learning modules and business process concepts via reading and discussion is an effective approach to teach ERP in all the four core courses. The combination of ERP simulation and case teaching can be applied to the business processes management course at the high abstract level. The hands-on case teaching method is recommended for enterprise systems and application development, because they are more technical and need to be taught in...
the organization context. The application development course is hands-on in nature for its focus on system design and development.

CONCLUSION

The contribution of the paper is to provide IS educators an innovative approach to integrate ERP into multiple core and elective courses in IS curriculum design. The framework uses the curriculum model of IS 2010 and blends in both fundamental and advanced ERP materials into four core courses and three electives. As such, ERP does not have to be taught in one single course, but in a variety of courses with different but integrated topics. This approach will provide an important and practical guideline for IS curriculum design that is set to follow the shift in IS education from applications development to enterprise software implementation and configuration.

ERP software is vital to facilitate effective pedagogical methodologies in ERP education such as hands-on experience, case teaching, technical implementation, and simulation. For illustration purpose, the paper currently is SAP orientated. Institutions can certainly choose other ERP packages such as JD Edwards, Oracle, PeopleSoft, SSA Global, Microsoft Dynamics, and so on. Thus, general usability of the proposed framework is recommended.

REFERENCES


