

ASSESSMENTS AND OUTCOMES OF AN ERP/SAP FUNDAMENTAL COURSE

Ming Wang, California State University, ming.wang@calstatela.edu
El-Hussein E. El-Masry, California State University, eelmasr@calstatela.edu
Xuesong Zhang, Southeast Missouri State University, xzhang@semo.edu

ABSTRACT

This paper presents a comprehensive approach to teaching ERP/SAP with the course assessments and learning outcomes. The course emphasizes on teaching SAP implementation as the whole process of transforming ERP business procedures to organization wide requirements. The learning outcomes were assessed via the course assessment exam and the course survey questionnaire at the end of the quarter. SAP is utilized as an ERP software tool in the course. Although both graduates and undergraduate students who took the course achieved positive learning outcomes, the significant difference in learning outcomes was identified between graduate and undergraduate students. The paper concludes with several suggestions to those who seek to teach enterprise system integration course.

Keywords: ERP, Enterprise Resource Planning, SAP, IS curriculum, business processes

INTRODUCTION

ERP is a platform that integrates all business functions with its centralized data repository shared by all the business operations in the enterprise. The enterprise-wide software system offers significant potential benefits, as suggested by the growing scholarly literature that seeks to conceptualize and measure types of organizational outcomes, business impacts, and return on investment among ERP adopting enterprises. But ERP systems are complex, learning curve is steep and their implementation is critical and challenging for many ERP educators. Unlike other computer applications, ERP/SAP includes the multidisciplinary scope of enterprise system concepts that requires internal cross-disciplinary coordination. Learners must acquire cross functional business process management and understand their functional area while implementing the ERP software.

There are a number of efforts that have been made to incorporate ERP implementation into IS

curriculum [1, 8]. Some ERP educators have responded to the challenges by using the case teaching approach to recreate the organizational context within which ERP implementations are conducted. The case study 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 [3, 5] 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. Instead of teaching solely on configuration activities, IS educators should focus on teaching topics that reflect the complex reality of ERP implementation.

By recognizing the limitations of case teaching methodology, the authors proposed a comprehensive framework to teaching ERP/SAP implementation which includes ERP/SAP infrastructure, implementation methodology, process modeling, business process reengineering and configuration and ERP/SAP landscape to corresponding SAP hands-on activities. At the end of the quarter, the authors conducted an evaluation questionnaire to explore learning outcomes and students' reaction to the course. In the conclusion, the authors offer several suggestions to those who seek to teach enterprise integration education. The paper is intended to serve as a useful teaching resource for those information systems (IS) educators who are interested in teaching ERP/SAP implementation courses. The remaining paper is organized in five sections: 1) course outline, 2) course materials, 3) hands-on activities 4) assessment and learning outcomes and 5) conclusions.

COURSE OUTLINE

The ERP/SAP Fundamentals course was taught to senior undergraduates and graduates in the Department of Information Systems for four quarters consecutively during the 2007-2008 year. The goal is to teach students to understand

business-centric information system and be able to implement ERP/SAP software. The proposed framework for teaching ERP/SAP implementation is presented in Figure 1. Introduction of each ERP/SAP topic is followed by a set of SAP hands-on activities. ERP

business process concepts are based on the contents in the textbooks [6, 7]. SAP hands-on activities are on based on the electronic downloads from the SAP University Alliance Curriculum Innovation Web site.

ERP Business Process Concepts	SAP Hands-on Technical Activities
ERP infrastructure and components	SAP interface navigation
ERP Core business processes	Application modules & business process procedures implementation
Business process reengineering (BPR)	Application modules Process modeling diagrams
Implementation methodology roadmap	Accelerated SAP
Enterprise model and organization structure	Fitter Snacker Configuration: Implementation Guide (IMG)
General ledger and controlling	Fitter Snacker Configuration: financial accounting
Organization structure	Business area customization
ERP Landscape systems	Testing Fitter Snacker configuration
Integrated business operations	ERPSim Simulation game [2]

Figure 1 Proposed framework for teaching ERP/SAP implementation

COURSE MATERIALS

SAP Infrastructure and Components

SAP infrastructure consists of application modules and business process procedures (BPPs). Each application module is a collection of a number of related business process procedures (BPPs), as illustrated in Figure 2. BPPs are the actual programs that provide the functionality of the SAP System. Many of these BPPs are used by more than one of the application modules. Business processes and business functionality found in the organization are built with these application modules and BPPs. The SAP business processes are accomplished via a very comprehensive set of BPPs available within the various application modules. The major SAP business processes are as follows.

- Manufacturing Planning and Execution.
- Procurement (purchasing).
- Financial/management accounting and reporting
- Customer Sales Order Management (sales).

Business Process Reengineering (BPR)

Business Process Reengineering (BPR) transforms organization operations to the entirely new and more effective business processes. BPR is primarily cross-functional in its focus. BPR involves questioning assumptions.

In the mid 1990s, especially workflow management systems were considered as a significant contributor to improved process efficiency. BPR is usually utilized in the Blueprint Phase.

There are numerous BPR approaches and they each differ according to the magnitude of the change and the change effort involved. Selecting the right model to teach BPR is thus a difficult task. We adopted the model developed by Guha et.al. [4]. This BPR model consists of six phases: 1) Envision new processes, 2) Initiating change, 3) Process diagnosis, 4) Process redesign, 5) Reconstruction and 6) Process monitoring.

Business Process Modeling

A process model is a graphical illustration of the business processes. It is a set of communication means that can be utilized by the ERP/SAP team members for BPR in the Blueprint phase. Two types of commonly used graphical representations are the Deployment Flowchart and Event Process Chain (EPC) Diagrams. They can both visually illustrate the process requirements and potential improvements that make the business processes more efficient.

Deployment Flowchart

The deployment flowchart uses the symbols of basic flowchart representing the flow of goods or data among individual roles or departments of an organization. The deployment flowchart is also referred to as a swimlane chart. Another widely used modeling tool is called the hierarchical modeling flowchart which provides the flexibility of describing processes in more or less details.

Event Process Chain (EPC) Diagrams

EPC is another graphical diagram that can be utilized to describe the process driven structure of enterprise systems. Unlike flowcharting, EPC enforces a strict structure using the structure:

event-function-event: for an event, its object + past participle; for a function, its verb + object. Figure 4 illustrates an EPC diagram with two XOR connectors showing that a salesperson can submit his/her expense report online if she has Internet access; otherwise she must send a paper report [7].

SAP Configuration

ASAP (Accelerated Systems Application and Products) Roadmap and Solution Manager drive configuration of SAP products. The ASAP methodology means nothing but standard process for implementation of SAP. The completed reference model is known as the Enterprise Model when the configuration activities have matched the business requirements to the processing available in the Reference Structure. The Implementation Guide (IMG) is a SAP system tool for actually making the settings that configure 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 extensively in the configuration of the R/3 System. About 80 percent of a typical SAP system installation and configuration is handled by the IMG configuration setting. Another 10 percent are enhancement of ABAP tools and appended structure, while the rest 10 percent are customer developed programs via ABAP tools. ABAP is the SAP’s programming language.

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. The Project IMG in Figure 2 facilitates the establishment of the organization arrangement during a company’s configuration by defining that structure.

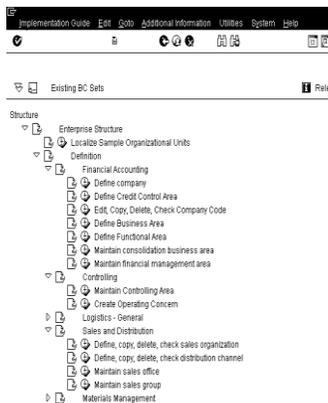


Figure 2 SAP Implementation Guide (IMG)

Organization Structure

The SAP Enterprise Structure is a model of the relationships among various SAP system organizational elements.

- The organizational diagram represents the organizational structure implemented within the SAP R/3 System.
- This organizational structure is a required prior to any SAP configuration, regardless of the number of applications modules that are implemented for a particular company.
- The available organizational elements are the same whether the SAP R/3 System is being implemented for manufacturing or service related industry.

ABAP Development Workbench

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.

ERP Implementation Methodology

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. It has proven to be effective when implementing the ERP/SAP solution across industries and different customer environments.

From an academic point of view, the use of the methodology has significant value as it is aligned with industrial standards and procedures defined in Project Management Body of Knowledge (PMBOK) Guide. The PMBOK Guide is an internationally recognized standard (IEEE Std. 1490-2003) that provides the fundamentals of project management as they apply to a wide range of projects, including construction, software, engineering, automotive, etc. This

guide is consistent with other management standards such as International Organization for Standardization (ISO) 9000 and the Software Engineering Institute's Capability Maturity Model® Integration (CMMI).

In practice, ASAP makes it easier to assign consulting tasks among different projects effectively and to provide an increased level of consistency. The Solution Manager is the SAP platform that delivers the ASAP methodology. The ASAP methodology adheres to a specific road map that addresses the following five phases:

1. Project Preparation – Define the project's scope. Organize the team, the vendors and hardware.
2. Business Blueprint – Define the business process requirements; discuss configuration, discuss data migration.
3. Realization – Configure the system, write middleware interfaces, develop ABAP code.
4. Final Preparation includes testing and training.
5. Go Live – Begin using the system.

System Landscape

The SAP system landscaping is the environment where customization activities of SAP configuration are actually performed, tested and released to production. It consists of three systems: development, testing and production which are linked by the SAP transport routes. The 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 an organization set up its system for development system, quality testing system, and then production system. Thus, each change 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.

HANDS-ON ACTIVITIES

SAP technical hands-on activities are discussed in the following four sections.

SAP Navigation

Navigation in the ERP/SAP system is very important for students who have never used the system before. The most obvious learning need in adoption of an ERP system is to acquire

operational capability with the software. Navigation and systems operations are concerned with the actual use of the SAP system that focuses on how to utilize the software and perform business transactions. Navigation activities start with log-on to SAP, creation of multiple sessions, and use of title bar, menu bar, status bar, command field, functions of different icons and various types of help.

Implementation Exercises

The laboratory course materials were adapted from the implementation of an integrated business scenario provided by SAP University Alliance. Fitter Snacker scenario is designed to introduce implementation of integrated business processes through configuration of a small manufacturing with production approach called "make-to-stock". The case introduces students to learn the basics of business process integration by individually configuring a snack bar company in the SAP environment. The Fitter Snacker Client represents the fictitious Fitter Snacker Company that is used as an example in the Monk and Wagner's textbook [7]. Exercises for the Fitter Snacker's Client match with examples used in the textbook.

Implementation Project

After Fitter Snacker Company is configured, students are assigned to configure the Marshall Muffler Company project using the Fitter Snacker documentation modules as a guide and data provided from a preliminary site visit to Marshall Muffler. The primary goal of the configuration project is to produce a customized SAP system that can manage the purchase of raw materials, production and sales of mufflers for the Marshall Muffler Company.

Simulation Game

The Muesli Simulation game provides the SAP environment for students to experience an integrated enterprise system. Students are divided to teams. Each team operates 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 get the opportunity to make strategic decisions for recipe (product design), sale forecasts, production improvements, 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. Customers do not change through out the game, hence you may learn from past their behaviour. 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 in the ERPsim book [2].

LEARNING OUTCOMES

A course assessment test and a twelve-question course evaluation questionnaire were administrated at the end of the course. The course was taught to 12 graduate students (Grad) and 8 undergraduate students (Ug). Out of 20 students, 12 were male and 8 were female.

The course assessment test shows that that graduate students had higher performance than undergraduate students, though both groups who took the course achieved positive learning outcomes. Out of 100 points, the average score of graduate students was 91 and the average score of undergraduate students was 78. The difference between the two groups was 13 points. There was no significant difference in the assessment test performance between male and female students. The two lines in Figure 3 visually illustrated the different performance between the graduate students and undergraduate students.

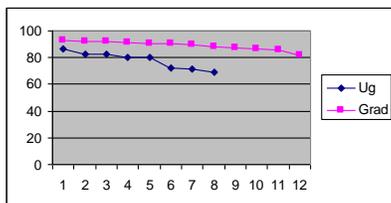


Figure 3 Assessment test scores of two groups

The 12-question course evaluation questionnaire measures students' previous ERP knowledge and SAP experience, perceived utility of various features of the course and learning outcomes from the course with rating from 1 to 5. The course evaluation questionnaire responses also showed significant differences in the two group means. Figure 4 indicated the significant differences between undergraduate students and graduate students are in the following questions.

Background Knowledge and SAP experience:

Q1. Pre-existence knowledge of enterprise system was (1: Little to 5: High);

Q2. The hands-on experience with SAP/R3 software was (1: Familiar to 5: new);

Learning outcomes:

Q11. I could become an effective manager in an ERP-enabled environment (1:No agreement to 5: complete agreement)

Q12. I have learnt the complete process of ERP/SAP implementation (1:No agreement to 5: complete agreement).

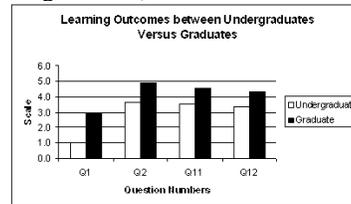


Figure 4 Difference between undergraduates and graduates on the questionnaire responses.

Q1 and Q2 in Figure 4 showed the graduate students have more pre-existence knowledge of enterprise system than undergraduate students, but they had less the hands-on experience with SAP/R3 software than undergraduate students regarding to students' previous ERP knowledge and SAP experience. Q11 and Q12 in Figure 4 showed the graduate students higher Learning outcomes than undergraduate students

CONCLUSIONS

The goal of the paper is to propose a comprehensive teaching approach which ties ERP fundamental knowledge to SAP implementation activities. Hands-on experience learning enables students to navigate in some areas of the ERP system, execute tasks, and learn some ERP technical skills, but provide no understanding of why tasks are being performed. The laboratory manuals focus on step by step instruction on task completion, not on business logic [9], Thus, hands-on learning experience has

limited value unless it reinforced with the in class discussion and review. The combination of hands-on laboratory learning and business process concepts learning via reading, discussion, and case study is powerful and effective approach to learn ERP/SAP fundamentals. It is a challenge to balance the two streams and relate the laboratory learning with business process integration in the course.

The purpose of the paper is to shift the teaching focus of ERP implementation from ERP technical issues to organization transformation process. The proposed framework takes into consideration of the various disciplines and different types of competencies needed to effectively transform business processes in an organization. Learning by doing activities make students motivated to learn new materials by themselves. One of the most important features of the comprehensive framework is that it focuses students' attention on the organization transformation process rather than on the technical aspects of ERP systems only.

The course assessment exam and the twelve-question course evaluation questionnaire showed both undergraduate and graduate students achieved positive learning outcomes from the course, but it seems graduate students achieved higher performance and benefited more from the course. This was because the two groups had different pre-existing knowledge in ERP and academic background. The results implicate that separation of undergraduates and graduates to different classes might be necessary to improve our teaching effectiveness.

ACKNOWLEDGEMENTS

The authors would like to thank Professor Roger Hayen, Professor Ellen Monk and Professor Bret Wagner for their ERP/SAP textbooks. We are also grateful to the SAP University Alliance Program for providing us SAP software, server hosting and high quality SAP laboratory materials.

REFERENCES

1. Davis, Charles and Comeau, Jana, "Enterprise Integration in Business Education: Design and Outcomes of a Capstone ERP-based Undergraduate e-Business Management Course". *Journal of Information Systems Education* v. 15 no. 3, 2004, p. 287-99.
2. ERPsimsim 2008 Tutorial Web Site: <http://web.hec.ca/erpsim/tutorialerpsim>
3. Fedorowicz, Jane; Gelinias, Jr. Ulric J.; Usoff, Catherine; Hachey, George, "Twelve Tips for Successfully Integrating Enterprise Systems Across the Curriculum". *Journal of Information Systems Education* v. 15 no. 3, 2004, p. 235-44
4. Guha, S.; Kettinger, W.J. and Teng, T.C., "Business Process Reengineering: Building a Comprehensive Methodology", *Information Systems Management*, Summer 1993
5. Hackney, R., McMaster, T. and Harris, A., "Using cases as a teaching tool in IS Education" *Journal of Information Systems Education* v. 14 no. 3, 2003, p. 229-234
6. Hayen, Roger. *SAP R/3 Enterprise Software: an Introduction*, McGraw-Hill, 2007
7. Monk, Ellen and Wagner, Bret, *Concepts in Enterprise Resource Planning*, 3rd.Course Technology, 2008.
8. Pellerin, Robert and Hadaya, Pierre, "An innovative framework for terracing reengineering and ERP implementation concepts", *Innovation Monograph II: Enterprise resource planning: Teaching and research*, pp 13-20. October 2006
9. Scott, Judy E. and Sugar Don (2004), "Perceived Effectiveness of ERP Training Manuals". Proceedings of the Tenth American Conference on Information systems, New York, pp. 211-3215.