

A Twelve-Step, Multiple Course Approach to Teaching Enterprise Resource Planning

Alan R. Peslak

Information Sciences and Technology

Penn State University

Dunmore, PA 18512, USA

arp14@psu.edu

ABSTRACT

The importance of enterprise resource planning (ERP) systems and an educational approach toward teaching ERP skills are the subjects of this article. The approach taken is to develop a comprehensive ERP multi-course training program using success factors both in practical installations and successful course activities. A thorough review of the literature and the author's initial experiences are combined to form a twelve step program that incorporates best practices of industry and education. The program is also compared to one of the more widely recognized frameworks in ERP systems education, the KnowDules of Watson and Schneider (1999) and is shown to incorporate all their factors as well as extending their model to include additional elements. The inclusion of all twelve steps in a three course sequence in Penn State University Information Sciences and Technology degree program is discussed. Within these courses, a strong emphasis on business function fundamentals, processes, and management is emphasized. The experiences of the author in two cycles of the sequence as well as selected activities within the courses are discussed.

Keywords: Enterprise Resource Planning, Business Process, ERP Education, SAP R/3 Instruction.

1. INTRODUCTION

Enterprise Resource Planning (ERP) systems have revolutionized business processes and information technology to support businesses. An ERP system is an integrated commercial off-the-shelf (COTS) software package that effectively performs all the required business functions of the organization. The original concept of ERP systems was a manufacturing system that included material resource planning, but with integrated modules in accounting, finance, human resources, and basic marketing. All of these were integrated and used a common database for non-redundancy of data entry and storage. This was then extended with advanced planning and more comprehensive customer relationship management. Under the definition of an ERP system, three requirements must be met:

- One database, updated and accessed in real time,
- Cross functional integrated processes and transactions,
- Seamless user transition between types of transactions. (Miller, 2003)

The market for ERP systems has grown significantly over the past several years. ERP systems have grown from zero to an \$8.9 billion market in 2002, with an estimated growth to \$11.9 billion in 2007. (ArcAdvisory Group, 2003) The extent of the prevalence of ERP systems can be illustrated by the fact that seventy percent of the Fortune 1000 have or will

have ERP systems. (Bingi et al., 1999) With such a large software penetration of ERP in industry, it is important that information systems students gain understanding of the software and its uses.

Duplaga and Astani (2003) surveyed manufacturing firms on their ERP implementations and found that two of the problems associated with ERP implementations included lack of ERP training, lack of ERP expertise, and lack of ERP goals. Bingi et. al. (1999) also notes two problems with ERP implementations are the lack of skilled talent and the skill set of employees.

2. OVERVIEW OF A 12 STEP MULTI-COURSE APPROACH

This report is a review of a pedagogical approach to teaching enterprise resource planning technology. Clearly, ERP systems represent a significant force in modern business of all sizes. With a strong "large" customer base, ERP vendors have begun to penetrate small and medium sized businesses. It is important that information technology professionals understand and develop skills to be able to implement ERP systems. The importance of ERP education has been recognized by many researchers including Watson and Schneider (1999), Joseph and George (2002), and Selen (2001). The methodology to teach ERP to undergraduate students has also been explored by researchers such as

Becerra-Fernandez, Murphy, and Simon (2000), and Guthrie and Guthrie (2000).

This report is one of the few to both review the literature and from a researched perspective summarize the skills and processes that are essential for ERP success. The author first approached ERP education in a two course sequence in academic year 2002-2003. The author taught ERP through a portion of IST 321 (now 420), Systems Integration I. This course included an overview of ERP theory via lecture and readings using the Course Technology book, Brady, Monk, and Wagner (2001), Concepts in Enterprise Resource Planning, ISBN 0-619-01593-4. Unfortunately, though the text included much important information, the students did not achieve the course objective of learning ERP systems due to two factors – their lack of any hands-on training and their lack of knowledge of any underlying business concepts, functions, or processes.

In the second course IST 421, Systems Integration II, actual hands-on use of SAP was included. Penn State University is fortunate to be a part of the SAP (German software producer) University Alliance. In 2002-2003, the SAP ERP software was hosted on a single server at University Park but was available for limited use by our students at our branch campus. Unfortunately, IST 421 also had limited success for several reasons. First, the students still did not have a basic understanding of business processes. The study of ERP theory and practical application were also disconnected. And finally, there was only limited SAP R/3 functionality, which did not allow company installation, reporting, or programming. After the limited success achieved in this first attempt at ERP education, the approach was to develop a new program utilizing a comprehensive literature review, an understanding and addressing of past problems, and a more thorough approach to ERP education.

The methodology used to develop a revised approach to an ERP program was to first review the literature and determine past approaches. This was combined with lessons learned from the initial attempt and other related information. The result was the development of a 12 step three course approach to ERP education. The approach begins with basic instruction in business, functions, management, business processes, and an introduction to SAP R/3. This takes place in the first course, IST 301, a junior level course. The course sequence continues with detailed analysis and hands-on activities in all SAP modules and processes as well as textbook supported theory and background in IST 420. Finally, the sequence concludes with actual creation of a new company, vendors, and customers and actual business processing in the new company in SAP R/3 (client/server version of SAP enterprise resource planning package) in IST 421. The standard course descriptions and sequence are provided in Table 1.

SAP R/3 is now hosted at University Park on multiple servers which allows for more advanced capabilities. The final course (421) includes production of establishment of a sample company, standard report generation as well as limited exposure to custom reporting with ABAP (Advanced

Business Applications Programming, SAP R/3's custom programming language).

Table 1 ERP Related Course Descriptions

IST 301 INFORMATION AND ORGANIZATIONS (3 credits) Overview of organizational structures and functions. Includes information processing and analytic perspectives of organizations.
IST 420 FUNDAMENTALS OF SYSTEMS AND ENTERPRISE INTEGRATION (3 credits) Introductory course on integration of information technology into different venues including the planning, development, and implementation of the integration. (This course was formerly numbered 321).
IST 421 ADVANCED ENTERPRISE INTEGRATION: TECHNOLOGIES AND APPLICATIONS (3 credits) Advanced course on the integration of information technology into systems applications.

The ERP skills and theories in this three course sequence are only a portion of broader course content focused on business process and systems integration which includes other topics such as enterprise application integration, ASP.NET, Visual Studio.NET Integrated Development Environment, Systems Analysis and Design, and Agile software engineering methods.

The twelve step program proposed is as follows:

1. Basic background in business and management,
2. Study of business functions,
3. Transition to business processes – flow of information, cash, materials,
4. Exposure to SAP R/3,
5. Study of theory of ERP including case studies,
6. Hands on SAP R/3 module training,
7. Hands on module exploration,
8. New SAP R/3 company setup,
9. Setup of all major actors – customers, vendors, etc.,
10. Setup of necessary ancillary hardware/software – theory,
11. Standard reporting for SAP,
12. Introduction to ABAP and limited custom reporting.

One of the major inputs for the development of the 12 step approach was a thorough review of relevant scholarly research in ERP systems, ERP education, and business and management processes. The following detailed sections for each step review the relevant research and support the proposed approach. Also included are details of specific exercises within each step and where appropriate, the student evaluations and recommendations from these approaches. The author finally provides further refinement plans where appropriate.

3. TWELVE STEP PROGRAM SUPPORT AND DETAIL

3.1 Basic Background in Business and Management

The first step in understanding enterprise resource planning is comprehension of the underlying concepts of business and

management. According to Kane (2003) the path to successful business processes is an intimate understanding of the business. Selen (2001) proposes that ERP education needs to include study of basic business skills. Holland and Light (1999) suggest one of the key factors which they view as critical success factors for ERP implantation is a clear business vision.

The basics of business are covered extensively in the first course in the sequence, IST 301, Information and Organizations. The text used for business functions and processes is Ferrell, O. and Hirt, G. (2003) *Business: A Changing World* 4th edition, McGraw-Hill Irwin bundled with Mike's Bikes Advanced software, ISBN 0-07-4189115. The text provides an excellent overview of business and management. The course is taught primarily by content developed by the instructor as well as the text content. To understand business from an operational perspective, Mike's Bikes Advanced business simulation software from SmartSims was incorporated as a multi-week team exercise. The students were divided into groups and assigned management of a bicycle manufacturing firm. They were required to analyze their business from marketing, financial, manufacturing, and development perspectives and make a series of decisions about their firm. Each week they entered their decisions into the simulation program and their results were available the next day. Each week represented a year in the life of a firm. All the teams were competitors in the bicycle manufacturing business and the software allowed them to understand how their decisions are reflected in a competitive market. The students were extremely motivated to achieve their goal of maximizing shareholder value and they quickly learned the business functions and resource tradeoffs. Subjective feedback was very positive from this simulation and future versions of the course will continue to include this exercise and more closely evaluate student evaluation. One change in the course will be to allow two separate shorter iterations of the simulation. This will allow the students to learn from their mistakes and have the opportunity to incorporate their new decision skills with a fresh start.

One of the major topics covered extensively in the development of an understanding of the basic background in business and management is Michael Porter's (1985) five competitive forces of bargaining power of suppliers, bargaining power of consumers, threat of new entrants, threat of substitute products, and competition within the industry. The author has found that this model can successfully be used to develop an appreciation of all the major issues involved in competitive business activities. The author uses Starbuck's and Wal-Mart for analysis. A specific exercise is to analyze Starbuck's according to the five competitive forces. In an exam, McDonald's was used as a test case. The students were to analyze McDonald's according to the five competitive forces. Generally the students performed well on the exercise and the exam. The concept clearly focuses on the key factors of a business. The text covers most of the general areas of business and management and will be used again in future courses to provide the general framework in which to build ERP skills. Unfortunately, most students do not come with business

skills or courses and without these skills past attempts to provide ERP education without these skills proved unsuccessful.

3.2 Study of Business Functions

Closely related to a general business understanding is the concept of business functions. ERP is based not on business functions but on business processes, but business process rely on an understanding of the underlying business functions. Selen (2001) views ERP and management education as a "multi-functional task". A background in underlying business functions is thus essential. Somers and Klara (2001) extended the review of critical success factors in ERP implementation via a survey of 86 organizations and found one of the most important factors as interdepartmental and inter-functional cooperation. Palaniswamy and Frank's (2000) study of multiple actual ERP implementations revealed a series of factors which were used to measure performance both before and after implementation. There is a general importance held in interdepartmental and inter-functional communications, information, and understanding. Underlying all these research insights is the concept of successful functional understanding and operation.

The Ferrell and Hirt (2003) text provides a wealth of content on educating in business functions. Some of the chapters covered in the IST 301 course include Marketing, Accounting, Production, and Human Resources. These topics map fairly directly to the major folders in the SAP R/3 menu hierarchy and are essential for understanding of the system.

3.3 Transition to Business Processes – Flow of Information, Cash, and Materials

One of the most important but often neglected areas of ERP education is the understanding of underlying business processes. Without an understanding of these processes, a complete understanding of ERP software is unachievable. The importance of business processes and functions and inclusion in the curriculum has significant support in the literature.

Walker and Black (2000) stress the need for an overhaul of business school curriculum to match the changes that have taken place in the business world. Over the past several years business processes have risen to importance at the expense of traditional functional areas; yet most business school curricula still take a vertical perspective on management. With the advent of business process engineering, organizations have focused on overall opportunities to improve cross functional processes.

It has been recognized that all basic processes require a cross disciplinary approach. ERP education based on fundamental study of business processes is essential. According to the Walker and Black (2000) there are three primary reasons for adopting a process oriented business approach:

- It reflects the realities of the business world today.
- Process management is necessary to reap the cost and service oriented advantages gained from enterprise information systems.

- Process management allows study of the factors that impact organizational performance.

Ramiller (2002) suggests the need for integration of business process into information systems core concepts. His approach is to use case studies and an analysis of six factors in development of a work system – customers, products, business process, participants, information and technology.

Antonucci and Muehlen (2000) reviewed joint curriculum development of SAP. Two schools had implemented SAP R/3 and incorporated specific ERP courses into their respective university's curriculum. The collaborative effort between the two universities simulated a business to business process with communication and transactions between the two SAP installations. According to Rao (2000), the objectives of ERP systems are to support all types of business best practices and to implement best practices in business processes.

Joseph and George (2002) propose a concept of a learning community to instruct students in ERP systems. Learning communities are small groups of students and faculty who are focused on integration of curriculum across courses and across departments to encourage integration of diverse content into multiple areas of the curriculum. ERP systems are by their very nature cross-disciplinary and thus can be especially amenable to learning communities.

The authors conclude by suggesting that the challenges are large but surmountable and the benefits are worth the effort. ERP systems are a better way of accomplishing business process and functions and should be incorporated into information systems education through an integrated approach.

The study of process structure and flows of SAP R/3 are critical to the understanding of ERP software. Through the author devotes significant class time to discussion of business process flow charts included in the SAP 101 tutorial. The SAP 101 tutorial is a comprehensive training package that SAP uses to train new users in their ERP system. The tutorial includes nearly 800 pages of theory, background, and exercises in SAP R/3. The author also conducts a guided tour of the SAP package providing a direct comparison is made between business function and process theory and the practical application of these concepts in the SAP package. There is especially considerable lecture and exercises on the logistics process including the sales process, the production process, and the procurement process.

3.4 Exposure to SAP R/3

In order to begin to appreciate the complexity and power of ERP systems, at the end of the IST 301 course, after a firm grounding in business, business functions, and business processes, one week is spent exposing the students to ERP in a live demonstration of SAP R/3. In addition, access is provided to all students and a specific assignment is required. The assignment is

Please prepare a Visio diagram of major business functions as presented in the SAP hierarchy. You

should have a minimum of 10 functions and three organizational levels.

This assignment requires the students to examine SAP R/3 in relation to the business skills they have learned in the course. The assignment is a good transition to understanding the relationship between the business theory and exercises and the concept of ERP. This exercise has produced excellent results and positive subjective student comments and will be continued in future course cycles.

There is literature support to an initial exposure to ERP. Guthrie and Guthrie (2000) reviewed existing university experiences with inclusion of ERP into curriculum and found the first levels of technical immersion or actual use of the ERP hardware and software as: Enterprise Model – with lecture and demonstration only. Selen (2001) combines a call for business process education with exposure and development via study of ERP software.

3.5 Study of Theory of ERP Including Case Studies

The next step in the ERP sequence is to expand on the business function and process skills and provide a firm theoretical and practical background in ERP theory. The ERP text used is still the Course Technology book, Brady, Monk, and Wagner (2001), Concepts in Enterprise Resource Planning, ISBN 0-619-01593-4. The book provides good background in basic ERP concepts and theory and will be continued in future courses. The text is supplemented with considerable outside readings (including the Nestle case study available through CIO magazine), SAP 101 content, and lectures for a more complete understanding of ERP. SAP theory only rated a 3.1 on a scale of 1-5 for students in IST 420. Reasons given for those who rated the theory low was the disconnect between theory and practice. Solid theory needs to be followed up with working practical exercises.

Literature does not discuss theory inclusion but Stewart and Rosemann (2001) present a problem based learning approach to educating students with “industrial knowledge” of ERP. The project suggested that an area of development in educational activities should be development of a reference model. This reference model is discussed in the Monk and Wagner text. Also, Farrell (2001) notes a program at Dakota State University whose course objectives included an overview of the concepts of ERP,

- A view of e-business,
- Capabilities and necessity of ERP,
- ERP vendors,
- ERP PeopleSoft Solutions (another vendor),
- Hardware and software requirements.

3.6 Hands on SAP R/3 Module Training

In order to fully understand ERP systems there is a need for hands-on training. Both the author's experiences in his first attempts and literature support this concept. Hawking and McCarthy (2001) in presenting challenges of ERP education in Asia suggest three important aspects of ERP educational content and delivery:

- Need for increased knowledge of faculty and staff,
- Need for hands-on training by students,

- Costs of ERP software.

When the author first taught ERP, there was extremely limited hands-on training. The subjective student comments from this experience were generally unfavorable. The students could not understand the business processes and functions without hands-on activities. The next attempt included full access to the IDES database and a sequence of instruction utilizing exercises modeled after the SAP 101 tutorial. The results were better but still only average with a score of 3.2 on a scale of 1 to 5 with 1 being very poor, 5 being very good and 3 average. The hands-on activity was viewed only slightly above average. In discussions with students, the most important reason why the exercises were not rated higher was the problems with the SAP IDES database. SAP uses the IDES database for training purposes and has made the database available for University Alliance members for instruction. The problem is that the database is designed for training not for education and requires extensive maintenance to make current for a class. Some of the exercises did not work properly for either the instructor or the students and this soured some students on the overall process. The lesson learned from this activity was to forego using the IDES database for education and to create our own company both as a training exercise as well as a model for both initial exposure and subsequent hands-on exercises. Details of this approach are presented later in section 3.8.

3.7 Hands on Module Exploration

Watson and Schneider (1999) also note that for student success there should be a significant element of hands-on activities. Their multi-step program suggests a high level of activity in actual training. Benefits of an ERP exposure and education and implementation according to the authors are:

- Exposure to real world software,
- Enriched curriculum,
- Explored research areas,
- Development of a business simulator,
- Incorporation of a cross functional curriculum.

The IST 420 course in addition to providing a basic overview of major processes also includes a team exercise in module exploration. The exercise was

Comprehensive team review of a major SAP module. Where appropriate, flow diagrams, screen shots and explanations of operations should be included.

The paper must be a minimum of 5 pages double spaced, font 12. The presentation should be a minimum of 10 minutes.

Modules assigned will be: Logistics Controlling and Logistics Execution, Accounting, Sales and Marketing and Customer Service, Production and Production Process, Human Resources, Plant Maintenance and Quality Management

Initial attempts at module exploration were hampered by use of the SAP R/3 IDES training database. As a result the new company that is currently being developed in IST 421 (see

3.8) will be used in future classes of IST 301 and IST 420 to provide a more easily understandable company for students to explore. The overall student work was commendable given the limitations of the database. Rating of the exercise however again reflected the difficulties and frustration of the DB earning only a 3.0 on the 1-5 scale. The negative comments were almost all related to the database problems. Future iterations will incorporate the new company setup. This company will work, be a simpler example, and allow for more education and less frustration.

3.8 New SAP R/3 Company Setup

One of the major objectives of the IST 421 course is a new company setup from scratch. The author has attended SAP University Alliance training and worked through the establishment of a basic trading goods company and the addition of manufacturing capacity to this company. Students in IST 421 are currently developing a new company from the ground up, understanding all the interrelationships, processes, and alternatives that can be customized in SAP R/3.

Hawking and McCarthy (2000) review three different directions that ERP education can take:

- First, emphasize instruction and training in a specific ERP system. The author suggests this is the least preferable for academic institutions since it is viewed as short term training.
- The second approach is to focus on overall business processes but use an ERP system to illustrate and develop practical skills.
- A final approach is focused on ERP systems including "selection, implementation, and benefits".

This new company setup is a mini-implementation and include as much as possible all the decisions, issues, and processes that are involved in a new installation of a manufacturing company. This includes company codes, chart of accounts, and cost centers in this step 3.8 and setup of customers, vendors, products, accounts receivable, accounts payable, purchase requisitions, purchase orders, invoices, bills of material, and blanket orders in 3.9. Once this company is developed it will then be used for IST 301 and allow simple easy to understand SAP overview. It will also be available for use in IST 420 to allow illustration of all major processes as a pre-configured client.

3.9 Setup of All Major Actors – Customers, Vendors, Etc.

As noted in 3.8, the setup of all major actors and processes in the new company installation is a significant activity in IST 421. The students after setting up the company are populating the database with sample products, customers, and other related items.

- When completed steps 3.8 and 3.9 have included (SAP AG and the Rushmore Group, 2004):
- Establishment of chart of accounts
- Creation of vendor, material, and customer master records
- Development of complete sales processes from order to cash

- Development of complete procurement process from procure to pay

This overall progressive approach and multi-course concept culminating in a technical capstone is similar to Becerra-Fernandez, Murphy and Simon (2000). They report the incorporation of ERP in the curriculum of Florida International University. Their program includes a multi-step approach to the discipline. General business processes are covered via review of all SAP R/3 modules in the fall of the students' junior year. In the spring of junior year design and implementation of selected modules as well as data base applications are covered. In the senior year, a technical approach is taken in the fall with enterprise system administration covered as well as network design and administration. Finally, in the spring of senior year overall project management and systems analysis and design are the course work.

3.10 Setup of Necessary Ancillary Hardware/Software – Theory

In conjunction with any ERP implementation, legacy systems and required infrastructure need to be addressed. Stevens (2003) suggests that ERP systems require standards that allow interconnection with legacy systems and all modules, middleware to actually make the connections, and finally the ERP software itself. Ramillier (2002) also notes the need for understanding infrastructure and context in ERP education.

Cost and efficiency and standardization also play a major role in ERP success measurement. These management issues which should be discussed in ERP education include:

- Number of different computer systems,
- Degree of incompatibility among systems,
- End to end connectivity,
- Paperwork associated with order processing,
- Time to process order and deliver.

Finally, customer service is paramount in development of ERP success. (Palaniswamy, and Frank, 2000)

Primarily in IST 421, case studies are used to illustrate the infrastructure issues associated with ERP implementation. In addition, security is prominently discussed.

3.11 Standard Reporting for SAP

One of the major benefits of an ERP system is the ability to perform business analysis. A series of exercises are included in IST 420 and 421 to incorporate standard reporting from the logistics, controlling and financial modules. Watson and Schneider (1999) suggest the concept of a business simulator in developing ERP educational curricula. The reporting exercises are a natural component of a business simulation.

3.12 Introduction to ABAP and Limited Custom Reporting

Themistocleous, Irani, and O'Keefe (2001) support the idea that ERP systems are the most important development in business information technology. They developed a study to

review the integration of existing applications into ERP and found that most integrated suites do not provide full integrated infrastructure. Due to complexities of customization, most firms (2/3) adopt a vanilla package approach, but this approach only fills 30-50 % of IT needs. Even though ERP systems are touted as comprehensive approaches, they still require integration with existing systems or other IT needs. Thus, in instruction, more than a plain vanilla implementation should be covered. Implications of customization and legacy systems need to be addressed.

Since most installations will require some customization and most often some custom reporting, the inclusion of reporting in ABAP/4 is a natural extension for an information systems and technology based curricula. Due to time limitations, significant effort is not possible but some exposure is desirable.

4. TWELVE-STEP PROGRAM COMPARED TO KNOWDULES

One of the first major works on ERP in information systems education appeared in the Communications of the Association for Information Systems in 1999. (Watson and Schneider, 1999). Watson and Schneider first proposed the concept of a multi-layered approach to ERP concepts and education. They coined a term "KnowDules, short for knowledge module to categorize a series of ERP concepts which need to be assimilated to gain overall ERP knowledge. By defining these modules the authors then believe they can be captured and included across the curriculum in a series of information systems courses. This progressive approach to ERP training is similar to the approach the author has taken. The "KnowDules" and their content are as follows:

- 1) Enterprise systems – a general overview of the enterprise, planning, and business processes,
- 2) Process-centered systems – review of the cross functional nature of business processes,
- 3) Enterprise Process models – specific look at enterprise approach to business processes,
- 4) ERP planning and implementation – project planning for ERP,
- 5) Reengineering and change management – improving existing business process,
- 6) ERP security, controls, and audit – role of security in ERP,
- 7) Systems Administration – technical administration and operation of ERP system,
- 8) Developing Enterprise Applications – exposure to methods of custom reporting and programming,
- 9) Programming Enterprise Applications – actual ABAP programming,
- 10) Network Resource Planning- determining network architecture to support ERP implementation.

The twelve step program includes most of the elements of the ERP KnowDules and can be directly mapped to their proposal. Table 2 shows where each KnowDule is covered in the twelve step program.

Table 2 Twelve Step Program versus Watson and Schneider KnowDules

Twelve step program	KnowDule Covered
Basic background in business and management	Enterprise systems – a general overview of the enterprise, planning, and business processes
Study of business functions	
Transition to business processes – flow of information, cash, materials	Process-centered systems – review of the cross functional nature of business processes
Exposure to SAP R/3	
Study of theory of ERP including case studies	Enterprise Process models – specific look at enterprise approach to business processes
Hands on SAP R/3 module training	
Hands on module exploration	
New SAP R/3 company setup	ERP planning and implementation – project planning for ERP
Setup of all major actors – customers, vendors, etc.	Reengineering and change management – improving existing business process
Setup of necessary ancillary hardware/software – theory	Systems Administration – technical administration and operation of ERP system ERP security, controls, and audit – role of security in ERP Network Resource Planning- determining network architecture to support ERP implementation
Standard reporting for SAP	
Introduction to ABAP and limited custom reporting	Programming Enterprise Applications – actual ABAP programming Developing Enterprise Applications – exposure to methods of custom reporting and programming

Table 3 Twelve Step Program and Specific Classroom Sources and Activities

Twelve step program	Specific Classroom Sources and Activities
Basic background in business and management	Mike's Bikes Michael Porter's Five Forces Ferrell and Hirt text
Study of business functions	Ferrell and Hirt text and Mike's Bikes User Manual
Transition to business processes – flow of information, cash, materials	Custom developed flow diagrams Study of structure of SAP R/3
Exposure to SAP R/3	Hands-on exploration exercise with SAP R/3
Study of theory of ERP	Monk ERP text exercises, CIO articles
Hands on SAP R/3 module training	SAP 101 Tutorial
Hands on module exploration	SAP team project for students
New SAP R/3 company setup	Choose company and start company from scratch
Setup of all major actors – customers, vendors, etc.	Setup all key elements of database for SAP R/3
Setup of necessary ancillary hardware/software – theory	Review hardware/software requirements, address security all via case studies
Standard reporting for SAP	Prepare a standard reporting package
Introduction to ABAP and limited custom reporting	Basic ABAP tutorial Limited ABAP exercises

5. SUMMARY OF ERP CLASSROOM ACTIVITIES

Some of the specific exercises used in ERP have been mentioned previously. Table 3 summarizes activities utilized in each of the twelve steps.

Every one of the major resources suggested fits well into the concept of a multi-phased and multi-disciplinary approach to ERP education. The initial business process course provides

the background necessary to understand the broader business issues of top management commitment, human resources, training, and adequate manual systems. The mid level hands-on course develops basic functionality in hardware, and software. Finally, the actual company installation provides a broader perspective of the need for "lack of customization", development of the best people, and the need for centralization.

6. CONCLUSION

The multi-step PSU approach incorporates these models including lecture and demonstration, hands-on assignment, skills instruction, and an integrated multi-course practicum. The IST 301 course includes primarily an enterprise model with emphasis on business processes but also demonstrated with SAP and allowing limited exposure to the software. IST 420 builds on the initial concepts of 301 but includes very specific hands-on assignments and projects. IST 421 is primarily an integrated practicum where students use knowledge of business processes gained in IST 301 as well as SAP specifics learned in IST 420. Students then create companies, develop standard reporting, and finally do limited customer reporting

The author is completing implementation of the new 12 step approach to ERP education and has seen significant positive results. Students now understand basic business concepts and processes and can gain a much better appreciation and understanding of the enterprise resource processes. This leads to informed students who can sort through the intricacies of SAP R/3 and not be hampered by lack of basic functional understanding. I am currently taking these students from a general knowledge of business and ERP into an actual implementation mode. This is proving to be greatly improved over other attempts due to a firm grounding in both theory and application. I encourage other instructors and researchers to explore this approach and contact me with their results. From this framework I hope to aid in the development of the next generation of ERP developers and implementers.

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AUTHOR BIOGRAPHY

Alan Peslak is an Assistant Professor of Information Sciences and Technology at Penn State University, Dunmore, PA. He received his Ph.D. in Information Systems from Nova Southeastern University, Fort Lauderdale, Florida. He has over 25 years of industry experience. Dr. Peslak's current teaching includes Systems Integration, Enterprise Resource Planning, Business Processes, Human-Computer Interaction, and Software Engineering. His research includes these areas as well as the societal, economic and ethical impacts of information technology. He has published in the *Journal of Computer Information Systems*, *First Monday*, *Information Research*, *Journal of Government Information*, *Information Resources Management Journal*, and the *Information Systems Education Journal*. He is a member of ACM, AITP-EDSIG, Financial Executives Institute, IACIS, and ACM-SIGMIS.

