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An Enterprise System and a Business Simulation Provide Many Opportunities for Interdisciplinary Teaching

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Abstract

Enterprise systems provide companies with centralized data management, business process support and integrated data flow between functional areas. Thanks to academic alliances offered by companies such as SAP, Oracle, Microsoft and others, universities can also take advantage of the integrated features of enterprise system to give business students an interdisciplinary learning experience. Businesses have found that having an enterprise system does not automatically lead to a competitive advantage and employees may not take advantage of better access to data for analysis and decision-making. There is a gap in the workplace between users' skills and what they need to know to fully utilize enterprise systems. To truly be "knowledge workers" employees need skills in five areas: (1) technical, (2) statistical and analytical, (3) knowledge of data, (4) knowledge of the business, and (5) communication/partnering. Business school graduates with hands-on experience with enterprise systems have a stronger set of knowledge work skills and are better prepared to use enterprise systems. This paper describes what one business school in the southwest United States has done over a five-year plan to incorporate enterprise systems software into several courses and teach an integrated curricula. The goals of the plan were to give students hands-on experience with enterprise systems, teach a cross-functional perspective of business and help students understand the way to use enterprise systems for decision support. One course in particular is highlighted in this paper because of its extensive use of SAP enterprise system software and ERPsim, a simulation that runs in SAP.

Keywords: enterprise systems, interdisciplinary education, interdisciplinary teaching, cross-functional, enterprise resource planning, business curriculum

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1. INTRODUCTION

Despite the fact that many organizations have implemented an enterprise system, such as SAP, many have not reaped the benefits. The investment in technology and software do not lead to better decision-making if users cannot take advantage of the enterprise system. Enterprise systems users not only need technical software training but other essential skills (Chian-Son, 2005; Robey, Ross, & Boudreau, 2002; Celsi & Wolfinbarger, 2001; Willcocks & Sykes, 2000). Davenport et al (2001) identified five key competencies businesses need in their employees if they want them to make data-based decisions, i.e., use data from the enterprise system for business performance analysis. The five key competencies these knowledge workers need are (1) technical skills, (2) statistical and analytic skills, (3) knowledge of data, (4) knowledge of the business, and (5) communication/partnering skills. *Technical skills* include an understanding of enterprise systems software and knowledge of software used to extract and manipulate data. S*tatistical modeling and analytic skills* include an understanding of modeling and associated analysis constraints in order to interpret data analysis. To get the data for analysis requires *knowledge of the data*—what data are available and where. *Knowledge of the business* provides the context for interpreting data pertinent to decision-makers. Finally, *communication and partnering skills* enable employees to coordinate with others in addressing problems and making decisions for the business. Celsi & Wolfinbarger (2001) use the term "renaissance employee" for people with these skills that meld information technology with an integrated business perspective.

The enterprise system software available through academic alliances offered by major software companies such as SAP, Oracle, Microsoft and others, give business colleges the opportunity to provide students with an interdisciplinary learning experience and this paper presents an interdisciplinary teaching approach taken by faculty at a university in the southwest. This approach helps students integrate concepts from different business functions and develop the key competencies to be effective knowledge workers. One new course in particular, called enterprise resource planning (ERP), provides extensive experience with enterprise system software and business processes through a simulation written to run in SAP. The simulation, called ERPsim, generates a lot of transactional data in SAP which provides many teaching opportunities in the ERP class. Presented here is an overview of this ERP course and the ways faculty integrates accounting, finance, and information systems concepts in the coursework. This paper also shows how to build on the interdisciplinary experience for students by using data generated by the simulation in courses in other disciplines.

In this article there are some examples of how courses in accounting, finance, etc. can link concepts they cover to the concepts taught in the ERP course and vice versa. For example, an accounting course that teaches product costing or a finance course that covers performance ratios can be cross-referenced with the ERP course. This interdisciplinary teaching opportunity provides a cohesive learning experience for students and reinforces their understanding of cross-functional business processes (Ferrara, 2007; Strong, Fedorowicz, Sager, Stewart, & Watson, 2006; Cannon, Klein, Koste, & Magal, 2004; Bradford, Vijayaraman, & Chandra, 2003). This approach is also more flexible than the team teaching approach often proposed in recommendations for an integrated business curriculum (Ferrara, 2007; (Smith Ducoffe, Tromley, & Tucker, 2006).

2. MULTIDISCIPLINARY TEACHING OPPORTUNITY

Background for Five-Year Plan

Several business faculty members developed and implemented a five-year plan to incorporate enterprise systems software into several courses. The reason for this plan was to give students an integrated experience with the business disciplines. This plan (http://business.nmsu.edu/erp) included changes to existing courses and a new enterprise resource planning (ERP) course with extensive use of SAP.

Since enterprise systems software is complex and has a significant learning curve, the faculty picked one to focus on. SAP was chosen because of its standing as the industry leader in enterprise system software and the specific benefits of its academic alliance (http://www.sdn.sap.com/irj/uac). (A few faculty have also used other software, such as Microsoft Dynamics' GP and Oracle Enterprise Applications.) It was fortuitous that a new curriculum benefit was added to the offerings in the SAP academic alliance just as the ERP course

was first offered. This new teaching tool was ERPsim, a complex but engaging simulation that runs live in SAP (http://erpsim.hec.ca/). The combined experience of working with SAP and running a business via ERPsim in the ERP course has provided an excellent platform for building the key competencies of students.

Overview of the ERP Course

The ERP course teaches concepts and provides experiential learning. The concepts covered include integrated business processes, demand forecasting, material requirements planning, supply chain management, data management (master and transactional data) and data analysis. There are several hands-on exercises using SAP through which students become familiar with the software while they learn the details of the business simulation in which student teams manage companies operating in the same industry. The business simulation has manufacturing companies in the cereal industry. Teams of students run the companies—making decisions about production, procurement, marketing, and product pricing. They must implement these decisions using SAP and they must glean information from the large quantity of data the SAP enterprise system holds for decision support. The simulation can have up to eight runs with each run lasting one class period (a run simulates 30 days).

Coverage of course concepts are interjected between simulation runs so the completion of the simulation takes several weeks. One example of interleaving teaching with the simulation: between two simulation runs, the teacher can take one or more class periods with the students to discuss demand forecasting and its impact on material requirements planning and inventory management. During these "concepts" sections, concepts and terms can be covered in depth, followed by seeing these terms put into practice during the simulation.

The specific learning goals of the ERP course help students build their skills in the targeted competencies for effective knowledge workers. Table 2 shown in Appendix A outlines the coverage of key competencies in the ERP course. Students gain technical skills and learn about the data that supports business processes. They analyze data and use that information along with their understanding of the business, to make strategic and operational decisions. These competencies also require a grounding in the business disciplines—accounting, finance, marketing and management.

3. INTERDISCIPLINARY TEACHING

The data accumulated in the enterprise system provides many ways to develop exercises that link to concepts in different business functions. Two example exercises are presented below. Each example shows how teachers of the ERP course can use enterprise system data to teach concepts from one of the business functional areas. Just as important, these examples show how the enterprise system data could be used in courses in other disciplines to enhance the interdisciplinary teaching experience for students. Without having students learn SAP, teachers in finance, accounting, marketing or management, can still take advantage of the the data extracted from the enterprise system.

Capacity Utilization

Figure 1. Spreadsheet for Capacity Utilization Analysis

	A	B	D	E	G	I	J	K
3	Production Schedule Report							
4								
5		Production Order	Start	Finish	Released	Confirmed	Total Boxes	Capacity Utilization
6								
7		1000477	27-Mar	28-Mar	03/07	23,144		
8		1000475	24-Mar	27-Mar	03/07	48,133		
9		1000473	22-Mar	24-Mar	03/07	41,838		
10		1000472	20-Mar	22-Mar	03/07	50,000		
11		1000471	18-Mar	19-Mar	03/07	36,781		
12		1000470	15-Mar	18-Mar	03/07	50,000		
13		1000469	13-Mar	15-Mar	03/07	37,634		
14		1000468	11-Mar	13-Mar	03/07	50,000		
15		1000402	10-Mar	10-Mar	02/12	2,259		
16		1000403	10-Mar	10-Mar	02/12	266		
17		1000401	7-Mar	9-Mar	02/12	50,000		
18		1000399	4-Mar	7-Mar	02/12	50,000		
19		1000398	2-Mar	4-Mar	02/12	50,000		
20		1000395	Feb-29	1-Mar	02/12	50,000	540,055	72.0%
21		1000394	27-Feb	Feb-29	02/12	50,000		
22		1000391	24-Feb	26-Feb	02/12	50,000		
23		1000390	21-Feb	24-Feb	02/12	50,000		
24		1000389	19-Feb	21-Feb	02/12	40,000		
25		1000386	16-Feb	19-Feb	02/12	50,000		
26		1000385	13-Feb	16-Feb	02/11	50,000		
27		1000382	11-Feb	13-Feb	02/11	50,000	340,000	45.3%

An exercise in the ERP course that references accounting. In a manufacturing company it is important to understand the concept of capacity utilization, a concept taught in cost accounting. In the ERP course capacity utilization is taught then students are given an exercise in which they must analyze their company's production volume, the allocation of production facility overhead expense and the impact on per-unit cost for their products. The spreadsheet in Figure 1 shows production data in the first four data columns that were extracted from SAP for a company. This data shows that total production in one simulation run was 340,000 units and 540,055 in the next run, with capacity utilization of 45.3% and 72.0%, respectively. For this part of the exercise students took the data extracted

from SAP and built the spreadsheet to compare total production with production capacity.

Next in this exercise, students use a customized screen in SAP that shows the impact of capacity utilization on the estimated per-unit cost. Figure 2 in Appendix B shows the per-unit cost for one product based on the assumption that productivity or capacity utilization is 75% (this is the level the companies start with in product cost estimates). In the lower half of the product costing screen the profitability analysis section shows the estimated cost per unit when overhead is allocated (the "Inc. Fixed" column heading). One box of this muesli cereal costs 3.26 to produce.

In this part of the exercise students are asked to compare their company's capacity utilization with the standard assumption of 75%. The next two figures in Appendix B show there is a dramatic difference in cost per unit when capacity utilization goes below 75%. At 45%, Note: In the Profitability Analysis section, "Incl. Fixed" is the estimated product cost overhead with included. The column labeled "variable" shows raw material costs and the columns starting with "DC" show the unit selling price in three distribution channels.

Figure 3 shows the cost of production for this muesli cereal went from 3.26 to 4.35. Figure 4 shows that capacity utilization of 72% still results in a notably higher per-unit cost (3.33 versus 3.26)

An exercise that cross-references the ERP course. In a cost accounting course, a similar exercise can be used as a introduction to product costing. With a short introduction to the simulation scenario, students in the accounting course can understand the type of business and products in the SAP simulation. If any students in the class have taken the ERP class, however, they could tell the other students about their company and the decisions they faced. No knowledge of the enterprise system software itself is needed in the accounting class. The accounting course could look at product costing in more detail for this simulated company and discuss the simplifying assumptions used in the allocation of overhead in the simulation.

Financial Ratios–Solvency and Profitability

An exercise in the ERP course that references finance. At the end of each simulation run financial ratios for each company are posted on a web site that every company in that simulation can view--much like real-world, publicly reported financial data for companies. Table 1 shows five ratios reported for one company over four simulation runs. Though this company's ratios show steady improvement, there are often two or three companies during a semester that fluctuate—sometimes improving, sometimes losing ground—perhaps providing more interesting analysis and interpretation.

Table 1. Financial Ratios For One Company Over Four Simulation Runs

Simu-lation Run	Gross Margin (%)	Net Margin (%)	ROE (%)	ROA (%)	Debto Equity (%)
2	50.1	4.6	2.1	0.9	145.4
3	50.7	11.1	7.3	3.1	136.7
4	54.3	19.8	16.6	7.4	124.5
5	55.2	23.0	23.2	11.0	112.1

Although the simulation does the calculations for each company's ratios and displays these as a summary after each simulation run, it is good to have students repeat these calculations. Each company's financial report—balance sheet and income statement—can be downloaded from the enterprise system and imported into a spreadsheet. Students in the ERP class learn how these ratios are calculated from the financial data, and then they interpret what the ratios say about their business' performance.

Since financial ratios are most meaningful when they are compared with other ratios, a subsequent exercise could have students compare the same company's ratios over time. Has the company improved its financial position? What do the changes in gross margin, net margin, etc. tells us about this company?

An exercise that cross-references the ERP course. In a financial analysis course data from a simulation for several student-run companies could be analyzed and comparisons made. This exercise could have students compare each company's profitability with other companies using the ratios to explain the conclusions drawn.

Sequence and Variable Data

The sequence in which students take the ERP and accounting or finance courses should not be an issue. For example in the accounting course, students who have already taken the ERP course will reinforce and extend what they learned about capacity utilization in the ERP course. Students who have not yet taken the ERP course will have a better frame of reference when they are in the ERP course and helping their teammates manage their business' production.

The data used in exercises could change between exercises and between semesters. Within a given semester, there would be data for multiple companies in SAP so every student would not have to use the same data. Also, because the ERP course is taught every semester, often with multiple sections, the data used in any of the cross-referenced courses can vary each semester. The exercise instructions and analysis can remain the same but the interpretation can vary based on a different set of data extracted from the enterprise system.

4. OTHER ENTERPRISE SYSTEM SOFTWARE

Clearly, the integration effort of this college takes advantage of SAP and the ERPsim simulation written for SAP. It is likely, however, that other enterprise system software, such as Oracle Enterprise Business Applications or Microsoft Dynamics GP, would offer data that could be used in a similar fashion to create cross-functional exercises. As long as the enterprise system contains transactional data there are opportunities for multidisciplinary exercises.

5. OTHER MULTIDISCIPLINARY TEACHING OPPORTUNITIES

This paper used two exercises to illustrate how exercises in an ERP class could teach concepts from other functional areas, such as cost accounting and finance. Rather than taking the team-teaching approach often called for in the literature, exercises from a common source—such as the companies in the SAP simulation—offer an alternative for educators. There are many other opportunities to use the enterprise system data to link to business concepts from more than one discipline. Here a few more examples for interdisciplinary teaching:

- A cross-reference exercise could be made with *production and operations management* by looking at the impact of setup delays when a team's company decides to switch production from one product to another. The simulation has a built in delay when the product produced changes and this delay has an impact on capacity utilization. Exercises in the ERP class and in production management could teach students about the trade offs of reduced costs of longer production runs versus shorter runs that allow more responsiveness to market changes.
- A cross-reference exercise could be made to *financial analysis* by having students either in the ERP class or in a finance class compare financial ratios from one or more companies in the simulation with those of similar real-world companies.
- The simulation has three distribution channels each with different purchasing characteristics. A cross-reference exercise could be made to *marketing* by analyzing data for buying trends in conjunction with marketing and/or pricing decisions.
- The enterprise system software creates several accounting entries in the general ledger when certain activities occur in the business processes of procurement, production, and sales. A cross-reference exercise could be made with *accounting* to track the accounting entries generated from business transactions.

6. CONCLUSION

The enterprise system software available through academic alliances with major software companies offer colleges of business the opportunity to prepare students to be effective knowledge workers. Working with an integrated, enterprise-wide information system gives students an understanding of cross-functional business processes and offers many teaching opportunities to link concepts in one functional area to another functional area. This interdisciplinary teaching can help students develop key competencies to take full advantage of the enterprise system that supports the company they go to work for. The teaching exercises presented in this paper illustrate how data from an enterprise system can be used in multiple courses across disciplines for an integrated learning experience that benefits students (Boyle & Strong, 2006).

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Editor's Note:

This paper was selected for inclusion in the journal as an ISECON 2010 Meritorious Paper. The acceptance rate is typically 15% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2010.

Appendix A

Table 2. Key Competencies for Knowledge Workers and Coverage in ERP Course

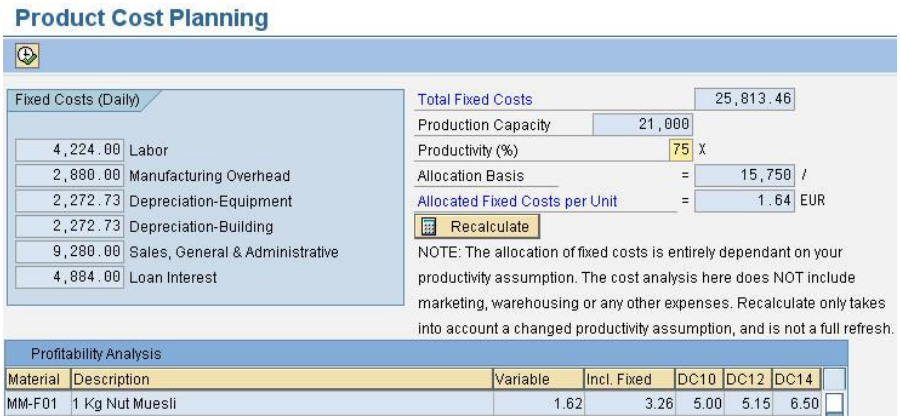
Competency	Coverage in ERP Course	Functional Areas Involved
Technical skills	• Extensive experience using SAP. • Locate data. • Export data.	• Information technology
Statistical & analytic skills	• Analyze and interpret financial data. • Forecast and plan.	• Accounting • Finance • Statistics
Knowledge of data	• Learn about master data used in business processes. • Learn about transactional data generated in business processes.	• Accounting • Information technology • Management* • Marketing
Know of the business	• Learn common business needs addressed by the enterprise system. • Learn the specific characteristics of a business and its competitors (ERPsim simulation).	• Accounting • Finance • Management • Marketing
Communication & partnering skills	• Work with management team coordinating responsibilities and actions (ERPsim simulation). • Weigh alternatives and make decision.	• Information technology • Management

* Management includes supply chain management and production management

Appendix B

Product Costing Examples in Customized SAP Screen

Figure 2. Product cost estimate with capacity utilization at 75%



Note: In the Profitability Analysis section, "Incl. Fixed" is the estimated product cost overhead with included. The column labeled "variable" shows raw material costs and the columns starting with "DC" show the unit selling price in three distribution channels.

Figure 3. Product cost estimate with capacity utilization at 45%

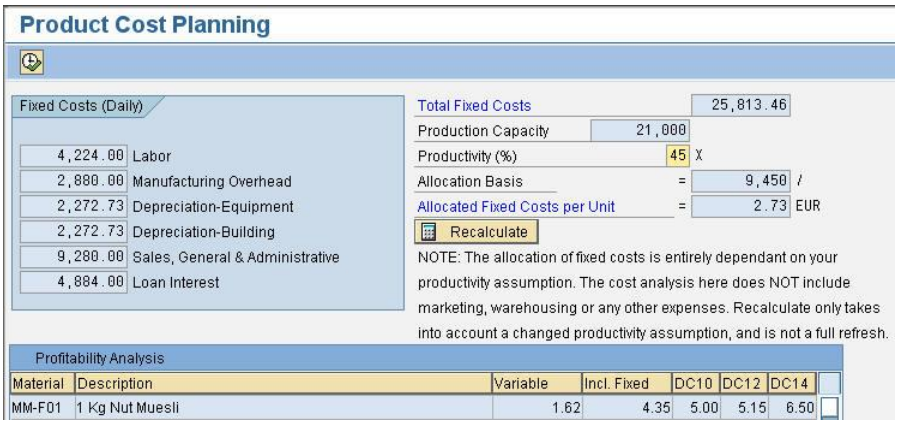


Figure 4. Product cost estimate with capacity utilization at 72%