Abstract

The Master of Engineering degree curriculum at Southern University, Baton Rouge (SUBR) includes a required core course titled “Engineering Management”. The course material was planned and developed for a period of over a year before the first offering in spring 2002 semester. The engineering management course covers the management principles and applications specifically useful to engineering and technical graduates. The main topics in the course are planning, forecasting, decision making, project management, time management, quality control, optimization, reliability and risk analysis, and scheduling. The engineering management course offers students with ample opportunity to demonstrate their mastery of course materials and related ideas through guided class discussions, open ended projects, assignments, research reports, and tests. The main distinction of this course when compared to a traditional management course is less emphasis on non-technical topics such as accounting and business management.

The observations and experiences learnt from the development and teaching of the engineering management course will be described in this paper. The future plan of utilizing SAP software modules\(^1\) in the graduate level engineering management course and in the selected undergraduate level engineering courses will be described. This plan is based on collaboration between the college of engineering and the college of business at Southern University in association with the SAP university alliance program.

I. Introduction

A desirable attribute of engineers is an understanding of business issues including management. The rapid changes in technology and globalization of trade require engineers to be astute managers. They must be able to integrate business knowledge into the engineering design-manufacturing process. College of engineering at SUBR is addressing this need in collaboration with college of business, in association with SAP\(^1\) university alliance program. This paper provides details of the college of engineering plans for SAP implementation in the curriculum. The effort aims at progressively introducing SAP modules in selected engineering courses and at adequately preparing faculty members for appropriate use across the curriculum. The use of other available software applications for analysis, planning, and decision making is encouraged in the undergraduate and graduate level engineering courses.
The Master of Engineering (M. Eng.) degree program at SUBR started in spring 2002 semester. The college of engineering houses four engineering departments: Mechanical Engineering, Electrical Engineering, Electronics Engineering Technology, and Civil and Environmental Engineering. The curriculum of M. Eng. program includes a required core course titled “MEEN 570: Engineering Management”. The course must provide core knowledge essential to successfully plan, organize, analyze, manage, and report engineering research and project work. The engineering management course covers the management principles and applications specifically useful to engineering and technical graduates. The main topics in the course are enterprise resource planning, forecasting, decision making, project management, time management, quality control, optimization, reliability and risk analysis, and scheduling. The students are provided access to SAP R/3 software application to reinforce their learning using the realistic industry database and analysis tools. Each class lecture covers the topics from textbook and reference materials. The learning is strengthened by showing examples using SAP R/3 and other software applications. Students are assigned homework and project assignments every week. In addition, students are required to complete a semester long open ended project in their area of interest. The project reports must include a problem statement, goals and objectives, informed facts, list of resources and references, project plan, literature review, research data, analysis, decision criteria, recommendations, and conclusion. Students are required to submit a mid-semester progress report, a final project report, a poster, and in-class presentation. The engineering management course offers students with ample opportunity to demonstrate their mastery of course materials and related ideas through guided class discussions, open ended projects, assignments, research reports, and tests. The main distinction of this course when compared to a traditional management course is less emphasis on non-technical topics such as accounting and business management.

II. Lessons learnt from Engineering Management course taught in Spring 2002 and 2003

The catalog description of MeEn 570: Engineering Management course is as follows: “Introduction to broad field of engineering management with specific emphasis on subjects such as project management, value engineering, constrained optimization, maintenance management, and enterprise resource planning (ERP). Students will be required to perform projects in selected areas.” The course uses a textbook and two suggested references. The course objectives are:

1. To provide students with introduction to foundational principles of engineering management
2. To develop sufficient problem solving skills through design and optimization exercises, project management assignments and case studies.
3. To train students to identify, formulate and solve engineering management problems in a dynamic environment.
4. To introduce students to management concepts, time management, planning and network scheduling techniques.
5. To introduce students to reliability issues, cost control, quality control management and simulation techniques.
6. To introduce students to integrated business management software such as SAP.

The class covers the following topics:
Weeks 1-2  Introduction to Engineering Management and ERP
Weeks 3-4  Planning and forecasting, Decision making
Weeks 5-6  Project management, Network Scheduling Techniques
Weeks 7-8  Reliability and risk analysis
Weeks 9-10 Design Coordination and Total Quality Management
Weeks 11-12 Capacity Management, Supply Chain Management
Weeks 13  Planning and Organization for Maintenance
Week 14-15  Project Presentations

The grade for this course is composed of class participation and assignments (20%), Case study and project report (40%), Midterm examination (15%), and Comprehensive Final Examination (25%). The minimum passing grade in all graduate courses is “C”. Students are required to get a composite score of 60 or more to pass this course. The assessment for this course is carried out as per the tables shown below:
<table>
<thead>
<tr>
<th>Course Objective</th>
<th>Intended Educational Outcomes</th>
<th>Means of Assessment</th>
<th>Criteria of Success</th>
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</table>
| **Objective 1:** To provide students with introduction to foundational principles of Engineering Management | 1.1. Students will demonstrate an understanding of the principles of engineering management  
1.2. Students will demonstrate the ability to analyze system theory and concepts | 1. Locally developed exams and homework  
2. Course opinion survey  
3. Basic knowledge and skills (BKS) Competencies Evaluation | 1. 80% will achieve critical level of performance (CLP)  
2. 90% positive response  
3. 90% gain high competencies level |
| **Objective 2:** To develop sufficient problem solving skills                     | 2.1 Students will demonstrate the ability to apply basic management principles to selected cases and applications  
2.2 Students will demonstrate the ability to analyze and plan network scheduling techniques and time management | 1. Locally developed exams and homework  
2. Course opinion survey  
3. BKS Competencies Evaluation | 1. 80% will achieve critical level of performance (CLP)  
2. 90% positive response  
3. 90% gain high competencies level |
| **Objective 3:** To introduce students to time management, planning and network scheduling techniques. To introduce students to pricing, cost control and quality control management | 3.1 Students will demonstrate an understanding of pricing and estimating  
3.2 Students will be able to solve problems involving cost control  
3.3 Students will demonstrate an understanding of design coordination and total quality management, and capacity management and planning. | 1. Locally developed exams and homework  
2. Course opinion survey  
3. BKS Competencies Evaluation | 1. 80% will achieve critical level of performance (CLP)  
2. 90% positive response  
3. 90% gain high competencies level |
| **Objective 4:** To train students to identify, formulate and solve engineering management problems in a dynamic environment | 4.1 Students will demonstrate an ability to apply the principles of engineering management learned through the course to real world cases and problem.  
4.2 Students will demonstrate that they can determine the potential problems and produce most effective remedies to overcome engineering management deficiencies  
4.3 Student will demonstrate an ability and understanding of SAP integrated management system. | 1. Locally developed exams and homework  
2. Course opinion survey  
3. BKS Competencies Evaluation | 1. 80% will achieve critical level of performance (CLP)  
2. 90% positive response  
3. 90% gain high competencies level |
The information that you provide by means of this survey will be very helpful in assessment of intended outcomes of this course and overall assessment of the mechanical engineering curriculum. We appreciate your taking the time to give us your feedback. Rate both the emphasis given on topics coverage in the course and your perception of level of learning in each topic. Please feel free to use the space after the list to briefly explain any of your responses, especially if your preparation was less than adequate. For your ratings, use a scale of 1-5 with:

5=extremely high, 4=very high, 3=moderate, 2= low, 1=none

<table>
<thead>
<tr>
<th>Intended Educational Outcomes</th>
<th>Emphasis Given to the topics</th>
<th>Perceived Level of Learning</th>
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<tr>
<td></td>
<td>Too Much</td>
<td>Adequate</td>
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<tr>
<td>a. Students will demonstrate an understanding of the concept of Engineering Management and system theory</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. Students will demonstrate the ability to analyze management functions and time management.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. Students will demonstrate the ability to apply planning, network scheduling techniques, and project graphics.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. Students will demonstrate an ability to analyze the pricing and estimating techniques and apply cost control principles to real world cases</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. Students will demonstrate an understanding of design coordination and total quality management techniques.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f. Students will be able to understand and apply capacity management and planning</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>g. Students will demonstrate an understanding of planning and organization maintenance.</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>h. Students will demonstrate an ability to apply the principles of engineering management and all related topics to real world problems through case studies.</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>i. Students will demonstrate an ability to search new topics and techniques related to engineering management through term paper preparation.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>j. Students will demonstrate an ability and understanding of integrated management system using SAP software.</td>
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Optional Explanations:
Students provide a feedback using the course outcomes opinion survey. The teaching faculty makes the assessment of basic competencies and skills of individual students. The assessment results and feedback from alumni are used to continuously improve the course. The sample results of the course opinion survey are shown Figures 1 and 2. Out of the 13 students enrolled in course 10 students participated in the survey.

**Figure 1: Adequacy of topic Emphasis**

It is evident from Figure 1 that emphasis is too little on outcomes j (Integrated Management System using SAP software), g (planning and organization of maintenance), f (capacity management and planning), and e (design coordination and TQM). Students are expressing the desire to learn more using integrated software solutions such as SAP software. A similar message is received from discussions with our alumni and industry people. The same weakness is evident from Figure 2 illustrating perceived level learning among students.

**Figure 2: Perceived level of learning**
The opinion survey is not linked to the student grades: 11 students secured an “A” grade and 2 students secured a “B” grade.

III. SAP Curriculum Plan

SUBR strategy is to implement SAP R/3 into the curriculum for the College of Business and College of Engineering. The college of engineering plan is to introduce business issues in engineering curriculum in selected relevant courses as follows:

**MEEN 120 : Introduction to Engineering and Technology** - Introduction to University organization and procedures; engineering and ethics; engineering graphics including introduction to computer-aided design; and the engineering design process and its applications to practical problems. Introduction to SAP/R3 applications will be provided to high school students (Engineering Summer Institute) and freshman engineering students through demonstration applications. Prerequisite: High school trigonometry.

**MEEN 201: Manufacturing Processes laboratory** – Study of fundamentals of engineering materials and processes in manufacturing as related to design and production. Students will develop short seminars on the new advances in manufacturing processes and examine the economics of processes. Students will be given laboratory assignments in material removal, forming, casting, joining, heat treating, and computer-aided machining. Students will be provided SAP/R3 experience with job order, process costing, and manufacturing/maintenance scheduling through educational demonstrations. Prerequisite: MEEN 120.

**MEEN 570: Engineering Management** - Introduction to the broad field of engineering management with specific emphasis on subjects such as project management, value engineering, constrained optimization, maintenance management, and enterprise resource planning (ERP). Students will be required to perform projects in selected areas such as: Project management, resource planning, optimization, simulation, maintenance scheduling, value engineering, etc. using SAP/R3. Prerequisite: Graduate Standing or Consent of Instructor.

**MEEN 450, CIEN 482, and ELEN 493: Senior Design I** – Design projects are assigned to student design teams with emphasis placed on recognition, definition, synthesis, and analysis of the project. A technical report and a set of engineering drawings are required. Students will be encouraged to use SAP/R3 modules for the project management, value engineering, and resource planning. Prerequisites: MEEN 365 and Senior Standing.

**CIEN 310: Engineering Economy** – Economic principles and techniques used in making decisions involving the acquisition and retirement of capital goods by government and industry; time value of money; computer solutions for rates of return, and capital expenditures. Students will be provided with SAP/R3 experiences suitable for accounting and economic analyses. Prerequisite: ECON 200 or ECON 205 and MATH 265.

The SAP/R3 software provides the integrated environment necessary to implement complete enterprise resource model and full understanding of business issues. The base components of SAP/R3 include materials management (MM) and production planning (PP) modules. The new
dimension products of interest include advanced planner and optimizer (APO), business information warehouse (BIW), and product life cycle management (PLM). The currently available engineering management curriculum is dominated by accounting and business management material. The challenge is to develop new material necessary for engineering management education.

IV. Conclusion and Discussion

The experience of developing and teaching a graduate level course “MEEN 570: Engineering Management” was described in this paper. Assessment results and industry feedback stressed the need for introducing integrated business solution in engineering courses in general and engineering management course in particular. To address this need the college of engineering has developed the “MEEN 570: Engineering Management” course and a curriculum enhancement plan using SAP software application. This plan was briefly described. The challenge is to create and implement course materials suitable for engineering students to impact the business value chain.

Bibliography

1. SAP America, Inc. 2003. (http://www.sap.com/)

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Ghanashyam Joshi is currently an Associate Professor of Mechanical Engineering at Southern University, Baton Rouge, Louisiana. He received a B. Tech. Degree in Mechanical Engineering from Indian Institute of Technology, Bombay, in 1986, M.S. in Mechanical Engineering from North Dakota State University, in 1990, and a Ph.D. in Mechanical Engineering from Michigan Technological University, in 1993. He served as an ASA/NSF/NIST Research Associate at NIST, Gaithersburg, MD during 1993-94. Dr. Joshi's research interests are primarily in the areas of manufacturing, automation, robotics, vibration-based condition monitoring, and reliability engineering. Dr. Joshi is a registered Professional Engineer in the state of Louisiana.