Using the Baldrige Criteria To Teach Introductory Engineering Management Principles

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Abstract

All students beginning the graduate program in engineering management are required to take EMEN 5010, Introduction to Engineering Management. This course is designed to introduce these students to the fundamental principles and concepts of technical management and provides a first glimpse at the many topics that will be covered in detail during the graduate program. The challenge has been how to present this broad set of material in an integrated fashion that creates a cohesive picture of what technical managers face in the work place. To address this challenge, EMEN 5010 has been built around the framework of the Baldrige National Quality program Criteria for Performance Excellence. The seven Baldrige categories provide the broad scope necessary for such a course while the integrated nature of the criteria addresses the need for a cohesive and integrated picture. Student response to this approach has been positive with respect to the format, presentation, and value of the course.

Background

The Lockheed Martin Engineering Management Program (the Program) is in its 13th year of offering a Master of Engineering degree for working engineers preparing for early management assignments. The degree is offered both locally on campus, in the Denver metropolitan area via live television, and around the world asynchronously using videotapes. The nature and content of the degree program and the use of modern communication technology to engage remote students in this program have been described previously by this author.[1-3]

The first course in the Program is entitled Introduction to Engineering Management.[4] This course serves to introduce the Program and to provide the students a first-look at many of the management concepts and topics that they will encounter as they navigate the curriculum. It is designed to create awareness and perspective about the complex nature of managing a technical group in an organization. For most of these students this is their first exposure to management education, as their professional lives to this point have been largely devoted to technical engineering assignments.

The challenge is how to create a course framework that seems logical, necessary, relevant, and has real value for them. This last element is imperative as most of these students work full time and have a family life. Their expectations for value in their continuing education are high. These individuals are also strongly ingrained with an engineering mindset where clear initial and boundary conditions exist, and mathematics provides the primary vehicle to a single right answer. This is a tough mindset to overcome and presents a particular challenge for the first course in the curriculum. The course design then must be one that addresses the nature of the students, their biases about education, and the limitations under which they are pursuing graduate work.

Course Design

The course is structured around the seven categories of the Baldrige National Quality Program Criteria for Performance Excellence.[5] The seven categories and their relative weighting in the Baldrige assessment methodology are shown in Table 1.

Table 1. Baldrige National Quality Award Performance Categories and Their Weightings

Baldrige Categories	**Relative Weighting**
Leadership	12.5%
Strategic Planning	8.5%
Customer and Market Focus	8.5%
Information and Analysis	8.5%
Human Resource Focus	8.5%
Process Management	8.5%
Business Results	45.0%
	100.0%

The first sessions of the course are devoted to a course introduction, guidelines for successful remote team projects, and an overview of the entire Baldrige framework. The last two items are included since the students must complete a semester long team project which involves analyzing a mock company's application for the Baldrige Award. This aspect of the course will be described later in this paper. The remainder of the course sessions are structured around the seven Baldrige categories.

The detailed criteria under each category provide a framework for discussing management principles as they apply in the typical environment that a new technical manager encounters. This framework is universally valid since the Baldrige criteria by design are non-prescriptive. The focus in the criteria is on what a company, or in this case an individual manager, should be considering in trying to meet the responsibilities associated with each category. By not dictating solutions, the Baldrige criteria provide the flexibility that engineers seem to enjoy in tackling problems. Further, the integrated nature of the criteria demonstrates the complexity and interconnected nature of managing an organization and creates a context for the relevance of various topics that might not otherwise be considered. Table 2 illustrates the course emphasis as related to each of the seven Baldrige categories.

Table 2. Relationship between the Baldrige Categories and the Course Emphasis

Baldrige Categories	Course Emphasis	# Of Sessions
Leadership	Leading from a value system Creating a learning organization The manager as a leader	1
Strategic Planning	Strategic versus tactical thinking Managing from a plan Connecting to the corporate objectives Managing change Developing a local strategic plan	2
Customer and Market Focus	Internal and external customers Achieving customer satisfaction Creating value for customers	2
Information and Analysis	Converting information to knowledge Benchmarking methodology Document integrity and control	1
Human Resource Focus	Hiring and developing technical people Recognition and reward for engineers Organizing and managing engineering teams	2
Process Management	Identifying core process responsibility Mapping to a process model Improving processes The development process The supplier management process QFD and FMEA	2
Business Results	Cost of quality concepts Identifying key success factors Cost accounting approaches Financial reporting methods	1

The primary text for the course is the Baldrige National Quality Program Criteria for Performance Excellence booklet that is revised and published each year. To supplement this booklet, a series of article from *Harvard Business Review* are used that are related to one or more of the key topics of each session. In addition, a class discussion question for each session is posted on the course web tool creating the opportunity for collaborative learning through the threaded discussions.

Team Project

A pivotal element of the course is the semester long team project. Students divide themselves into teams of 5-7 with the caveat that each team must contain at least one student that is not collocated with the others. This is to give the students experience in remote teaming. Each student team evaluates a mock application for the Baldrige Award. This mock application is one of several available from NIST.[6] The teams look for evidence or lack of evidence in the

application of pre-identified management practices and methods that have been discussed during the course. The analysis of this application, which has been created to simulate how a real company might work, helps the students see how these practices and methods are actually realized in a company environment.

Student Evaluation

Students are evaluated on a open book/notes midterm and final exam that primarily use mini-case studies as the basis for questions and that have limited time and space for creating answers. The latter aspect is used to simulate the real management environment where responses to problems, inquiries, and opportunities often require quick and concise answers. The students also write critical analysis papers on three of the *Harvard Business Review* papers that are used in the course. Finally, the students are evaluated on the quality of the analysis of the mock application.

Student Feedback

Students are afforded the opportunity to complete a Faculty Course Questionnaire (FCQ) at the end of the course. The campus administers this feedback tool to maintain integrity and anonymity, and participation is completely voluntary. For the spring 2000 offering of the course, 21 out of 33 students responded. These 33 students were composed of 21 remote students and 12 on-campus with corresponding response rates of 48% and 92%. The response rate of the remote students is actually above average for this offering of the course. Historically, the response rates of remote students in the Program have been in the 25% to 30% range. The responses for several key questions from the FCQ relating to the relevance and value of this course and its approach are shown in Table 3. The range of possible responses is from a top rating of A (4.00) to a lowest rating of F(0.00).

Rating Statement	Numerical Average
Presentation of material	3.43
Relevance of assignments	3.33
Continuity of course work	3.15
Learning experience	3.33
Course rating	3.11
Overall value of the course	3.43

Table 3. Feedback from Students on the Course

Informal discussions with students at the conclusion of the course provided some additional insight on the approach used in this course. These discussions indicate that this approach has the potential risk of being perceived as a Baldrige training course or a traditional course in TQM. The use of the Baldrige Criteria for Performance Excellence booklet as the primary course text and the semester-long project to evaluate a mock Baldrige application could create this perception. Care must be taken to provide the proper context for using the Baldrige framework, and reinforcement of the reason for this approach must be done throughout the course.

Conclusion

An introductory graduate engineering management course has been built on the seven categories of the Baldrige National Quality Program Criteria for Performance Excellence. This approach provides a holistic, integrated perspective on management that allows engineers preparing for early management positions to gain an appreciation of the complexity and nature of technical management. Based on the student responses to the course feedback tool, this approach seems to be achieving its primary objective of initiating the transition of these students from engineer to manager. Using a Baldrige framework approach does create the risk of perceiving the course to be a TQM course or a training course for the Baldrige process. Using other learning resources and maintaining the proper perspective throughout the course may well mitigate this risk.

Bibliography

1. Daughton, W., "A Distance Education Graduate Program in Engineering Management – A 10-year Success Story", *Proceedings of the 1999 ASEE Annual Conference & Exposition, Session 2642 (on CD ROM) (1999).*
2. Daughton, W., "Fostering Team Learning Experiences for Remote students", *Proceedings of the 12th Annual Conference on Distance Teaming and Learning* (August 1996), p. 81.
3. Daughton, W., "The Enrichment of the Learning Experience of Remote Students Through Modern Communication Technology", *Proceedings of the 13th Annual Conference on Distance Teaming and Learning* (August 1997), p. 59.
4. URL: www.colorado.edu/EngMgmtProg/courses/EMEN5010
5. URL: www.quality.nist.gov/
6. URL: www.quailty.nist.gov/docs/99-case-study

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