

## **A Distance Education Program in Engineering Management A 10-year Success Story**

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### Abstract

The Lockheed Martin Engineering Management Program at the University of Colorado has been offering graduate degrees and professional certification for ten years. The program has been substantially funded by Lockheed Martin Corporation and was created to prepare full-time working engineers for early management assignments. Over 150 engineers at many companies, large and small, have successfully completed the program while continuing to hold professional positions. Since its beginning in the Denver-Boulder metropolitan area, the program has gradually expanded to reach engineers across the United States and around the world. Today there are over 120 graduate students accessing the program through modern distance education technology. The program structure, characteristics, and key success factors are presented, and the improvements being made to enrich the learning experience of distance education students are addressed.

### Background

The program evolved from discussion between the College of Engineering and Applied Science and local industry about the need to provide engineers with a practical set of management skills prior to undertaking early management assignments. High technology companies, such as the then Martin Marietta, were concerned that many engineers were entering management positions responsible for project or development teams or promoted to managers of small departments or work groups with little preparation. Ironically, these opportunities sometimes came as a reward for a job well done for engineering contributions but placed the individual in an awkward position. As Matson<sup>1</sup> and Lancaster<sup>2</sup> have recently reported, and this author observed while working in industry, engineers usually find themselves very poorly equipped to take on their management assignments. To exacerbate this situation, many individuals cannot leave the workplace for an extended period to obtain the essential management education. In some cases this even extends to attending during evenings and on weekends. Our students report to us<sup>3</sup> that business travel, work crises, and family obligations make attendance at regularly scheduled classes very difficult. In recent years, it seems that extended business travel and remote work assignments have become quite common, which greatly interferes with participating in traditional courses.

Just recognizing the need for management preparation does not address the reality that engineers often move into management positions before that preparation can be completed. As a result, there was a clear need to provide practical management techniques and methods in addition to

underlying concepts and principles during the course of the program. Ideally, lessons learned could be applied on the job soon after their introduction.

Based on the issues highlighted above, the program's guiding principles can be summarized as:

- A primary focus on engineers preparing for early management assignments
- A rich mix of relevant management theory and practices
- Flexibility and portability to meet the work and personal demands on students
- A format that effectively engages remote students
- An opportunity to include a technical area of emphasis associated with the manager's functional area
- A provision for an original research project on a management topic

### Program Model

The model of the program is shown in Figure 1. This model incorporates key elements that have proven to be important to the success of the program. The emphasis on collaborative learning between faculty members, students, and corporate guest lecturers has enriched the learning experience. Real world anecdotes, examples, and case studies have added credibility to the theoretical principles and concepts and added perspective on their applicability. The credibility of the program is built on the mutual respect of the three constituent partners with respect to real-world experience. Thus, a key success factor has been that all faculty members have significant industrial management experience.

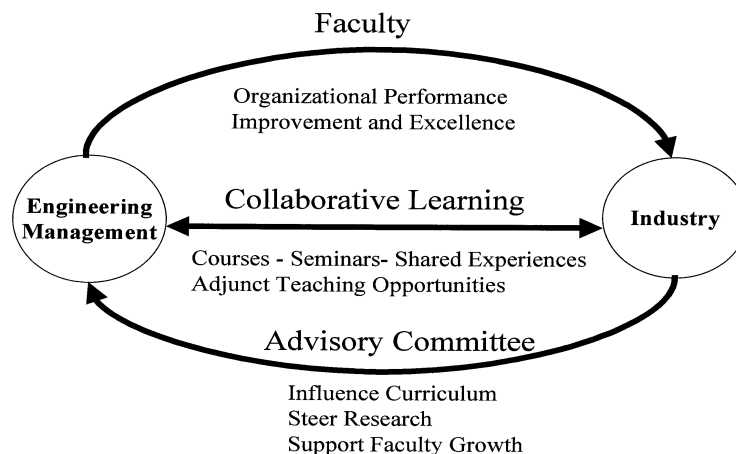


Figure 1. Engineering Management Program Model

A second element of this model is the opportunity for faculty to work with corporate partners on solving management problems. Faculty members and graduate students have been able to assist companies by providing expertise and time to deal with problems and needs more effectively. As examples, faculty and graduate students have assisted several companies with QFD studies and with organizational restructuring. These opportunities allow faculty members to advance their understanding and competency in management theory and practices. The final element is the information provided by the Advisory Committee to the Program. As shown in Figure 1, this

advice takes three forms. Perhaps most important is the input to the curriculum to ensure that topics identified as critical by industry are being adequately addressed. This responsiveness to industry is important to continuing support and collaboration.

## Curriculum

The program curriculum is illustrated in Figure 2. The program offers a set of six technical management courses that are highly integrated and provide a solid foundation of knowledge and skills for the new technical manager. These courses are required for both the degree program students and the professional certification students. For the degree program students, three technical electives are required that provide an opportunity to obtain a mini-focus area in a technical field of interest or potential future assignment. Students are encourage to select these

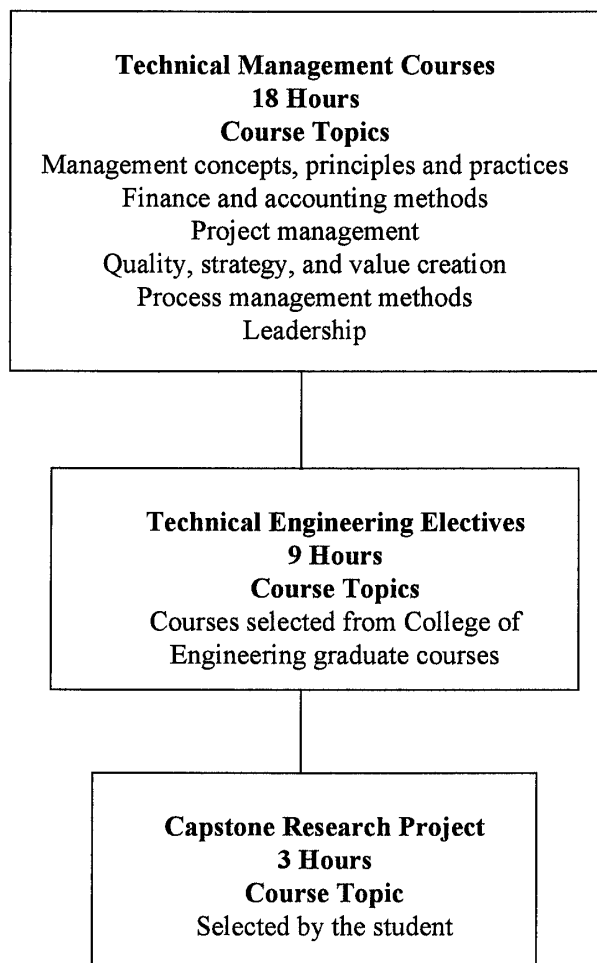


Figure 2. Engineering Management Curriculum

electives in the technical field which will be primary focus of the project, product, or group over which they will management responsibility. Finally, degree program students must complete a final capstone research project, which provides an opportunity for original and creative work. Selected topics usually focus on management issues or needs in their work environment. In many

instances, the student's company has implemented the results and recommendations from these projects.

Recently, an alumni survey<sup>4</sup> was conducted for our program by a former student. The purpose of the survey was to ascertain the value of the curriculum and the overall program to students throughout their careers. Alumni who were at least three years out of the program were selected so that an opportunity to apply lessons learned and access the impact could have been realized. Several key findings relative to the curriculum were gathered from the 56 surveys returned. The curriculum was cited as being very helpful to individual development by providing a good understanding of the business aspects of the corporate environment and in providing a basis for continuous, lifelong learning. These two items were linked by respondents to creating future job opportunities and contributing to long-term career objectives. A professional program such as this clearly must address these practical considerations if it is going to be successful. As far as individual courses are concerned, the respondents cited project management and quality management topics as the most important to improving job performance. These findings are not unexpected since early management assignments often revolve around managing projects, and the emphasis on improvement and other quality topics are pervasive in most companies today.

### Delivery System

Perhaps the critical success factor of this program is its delivery system. The courses are offered in three delivery modalities. Students may come to Boulder and attend classes live in the traditional setting. Typically about 10% of the students in a class of about 50 choose this option. Often, these are international students who have come to the Boulder campus with support of their companies, countries, or families for the duration of the program. Another 15% of a course's student population view the class sessions on live television with one-way video and two-way interactive audio. The courses are broadcast via microwave transmission to a radius of about 70 miles from the Boulder campus. There are about 30 company and public sites that have set-up the necessary equipment to receive the television signal. The remaining students in a course receive the classes through a videotape of each session. In-class and live television students also receive a videotape of each class session. In the first years of the program, approximately 50% of the students in a course utilized the live television modality. As mentioned above, that number has now dropped to around 15%. This change is very telling. The impact of downsizing and reengineering has increased the workload of many engineers, and increased business travel and extended remote assignments are also much more common. Students are finding it difficult to sit through a live television broadcast even early or late in the day. All of these factors have made the flexibility of the videotape option much more attractive. In the previously mentioned alumni survey<sup>4</sup>, the most frequent response to a question seeking information about the best attribute of the program was flexibility. Respondents to the survey<sup>4</sup> as well as current students typically indicate that, without the flexibility afforded by the delivery system, they could not pursue graduate study.

The potential downside of the use of the videotape modality is the isolation it creates. To provide a rich educational experience the challenge is to effectively engage the remote student. In this program, ample use is made of subscriber-based, asynchronous, e-mail discussion groups. In this forum, discussion topics are posted by the instructors and input solicited from the students. This approach allows remote students to express their opinions or share work experiences that would

otherwise go unheard. This forum also produces self-sustaining discussions between students generated by student-posted questions or comments. Since the students all have direct work experience, these interchanges create a rich collaborative learning environment and bring the students closer together. In many courses, class projects are assigned that must be done by teams of students. The team members must learn how to work together on the project while in many cases never actually meeting one another. This provides practical experience in remote teaming as well as forcing collaboration between otherwise isolated class members. The results of these efforts to engage remote students have been generally quite good and have been described in detail elsewhere<sup>5,6</sup>.

## Conclusion

The Lockheed Martin Engineering Management Program has effectively served its target market of working engineers preparing for early management assignments by providing:

- A sound foundation for the transition from engineer to manager
- A flexible program to accommodate the demanding schedules of the students
- A rich mix of theoretical and practical management education that can be readily applied
- A foundation for lifelong learning

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