Distance Learning: Recent Graduates Share Their Experiences and Recommendations

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Abstract

This paper discusses a graduate level engineering distance learning program, which started transmitting courses in 1994. The program currently has a dozen graduates. The graduates recently provided their perspective of the program. The information is shared in this paper.

Basis for the Program

Manufacturing Engineering is an important and growing aspect of technical education, research, and economic development in the United States. Concerns about U.S. competitiveness in manufacturing continue to grow and the global economy continues to emphasize the contributions of value-added manufacturing operations. Some of the important elements in today's changing economic environment are: demand for higher product quality; reduced time from concept to availability for sale; increased product output; and short product life cycles. The half-life of products has decreased to the point that 50% of product sales occur within three years of initial design. These factors have resulted in the absolute need for engineers who are prepared to initiate, design, plan for production, and control the manufacture of quality products. Economic survival in this environment requires the education of professionals who can integrate all the engineering and production functions required to manufacture a constantly changing array of new products.

II. Introduction to the Program

The Manufacturing Engineering Masters Program was established in response to industry input requesting continuing education opportunities for engineers working in manufacturing environments. Manufacturing Engineering is concerned with the application of specialized engineering and managerial knowledge applied to the development of productive systems of people and machines. Primary emphasis is on the design, operation and control of integrated systems for the production of high quality, economically competitive goods. The specific curriculum and course delivery modes were developed and established in partnership with industry through an Industry-based Technical Advisory Board (TAB). TAB had the following corporate representatives: Anderson Consulting, Boeing, Oregon Cutting Systems, Gunderson

Harris Group, Hewlett-Packard, Intel, James River, Precision Castparts, Sequent Computers, and Tektronix. TAB participants were generally training managers or mid-level operations managers. TAB decided that the distance learning program should be designed to provide engineers the opportunity to pursue professional level studies in practice-oriented subject matter not covered in most basic engineering undergraduate programs.

Program flexibility was of critical importance to enable working professionals to pursue graduate studies while concurrently meeting their job responsibilities. Flexibility was designed into multiple aspects of the program. The delivery mechanism was to include three modes: live classroom, satellite transmission, and video tape. Students would select the mode of delivery, which best meets their individual needs. Courses were to be offered in the 4 p.m. to 7 p.m. time period, Monday through Thursday at multiple viewing locations. Pre-requisites and sequential courses were to be minimized. Students could begin the program during any quarter. And four courses would be televised each quarter.

Potential courses were identified using a phone survey and several focus groups. A paired comparison analysis provided a relative importance ranking for the potential topics. The topics identified by the survey and focus groups are shown below in the order importance.

Total Quality Concepts
Manufacturing Systems Design
Problem Solving
Information System Design
Managing Change
Team Building and Management
New Product Design and Engineering
Environmental Health and Safety
Flexible Manufacturing
JIT and Inventory Concepts
Statistical Quality Tools
Goal Setting and Performance Measurement
Financial Planning and Strategy
Supplier Relationships
Advanced Manufacturing

With this input, four topical areas were identified for the Manufacturing Engineering Masters Program as described below:

1. Data Analysis- Courses in engineering statistics, statistical process control, and design of experiments.

2. Manufacturing Systems- Courses in manufacturing design, and production control systems.

3. Personnel Systems- Courses in managing change, team building and communication, strategic planning, and total quality management.

4. Technical Electives- Courses in mechanical engineering, electrical and computer engineering, and engineering management.

After six years we have 30 students formally admitted to the program. Since completion of the program requires approximately four years of part-time study, we have just recently reached a point of having a critical mass of graduates from this program. Twelve students representing eight companies have received their Manufacturing Engineering Masters Degrees through this distance learning program.

III. Graduate Level Distance Education Learnings

From the Perspective of the Graduates- A survey was recently administered to the graduates of this program in order to gather data for continuous improvement. The graduates of this program are engineers and/or managers at Boeing, Hewlett-Packard, Tektronix, Intel, Wacker Siltronics, Sun, Sequent Computers and S.E.H. America. The survey requested information in the following categories: courses offerings, course delivery, university interactions, the distance learning environment, background and preferences, and suggestions. The overall finding is that the program is meeting the needs of students interested in studying manufacturing engineering at the graduate level. The specific categories are discussed below.

A. Courses Offerings- Graduates were asked to evaluate the core courses relative to their learning experience in the course and the importance of the course to the Manufacturing Engineering Masters Program. The data suggests that the core courses are appropriate as the majority of students indicated that the current core courses are important (Table 1). In general, students had a positive learning experience in the majority of courses. The exception is statistical process control. Although 100% of graduates felt this was an important course, only 44% of graduates had a positive experience in the course. The data suggests that there is something different about this specific course that needs investigated further. Written comments indicated an issue with the instructor may exist.

	% of students indicating a positive experience	% of students indicating the course is important
Engineering Statistics	90	100
Statistical Process Control	44	100
Design of Experiments	88	100
Strategic Planning	80	80
Concurrent Engineering	75	100
Project Management	80	100
Manufacturing Engineering	80	100
Manufacturing Management	100	100
Communication & Team Building	100	88

Table 1 Program Courses

Course Delivery- Graduates were asked to evaluate their experiences relative to distance delivery and to evaluate the importance of various aspects of distance delivery. The data indicates an opportunity exists to improve multiple aspects of the delivery system (Table 2). Broadcast quality as evaluated as picture and sound quality has room for improvement. Issues with the availability of videotapes needs clarification and improvement. And the instructor-student flow of materials needs closer inspection to determine how to improve this area. All of these aspects of distance education are considered important and warrant further investigation.

	% of students indicating a positive experience	% of students indicating the aspect is important
'Live' Picture Quality	80	100
'Live' Sound Quality	78	100
Video Tape Availability	70	90
Video Tape Quality	86	100
Material Logistics	75	100

Table 2 Course Delivery

Interactions within the University- Graduates were asked to evaluate their experiences relative to different types interactions and to evaluate the importance of these types of interactions. Graduates indicated that several different types of interactions are important. Of the seven types of interactions evaluated, two types seem to require more information, interaction with the advisor and interaction during a broadcast (Table 3).

Additional data from the graduates indicates that the issue with the advisor is his/her availability to remote students. The interaction during the broadcast is a technology problem. Even though students are able to interact in real time with an instructor during a class, often there is feedback, static or just difficulty in understanding the student.

	% of students indicating a positive experience	% of students indicating this type of interaction is important
Advisor	83	100
Admissions & Graduate School Offices	89	100
Course Registration	90	100
Textbook Procurement	90	100
Instructors During their Class	63	88
Instructors Outside of Class	90	100
Final Defense	95	95

Table 3 University Interaction

Distance Learning Environment- Graduates were asked to evaluate the importance of different aspects or potential aspects of distance learning. Almost all graduates rated both email

correspondence and timely feedback of student work as very important aspects of a distance learning environment (Table 4). At the same time, regular and scheduled discussion with the instructor (outside of class) and instructor office hours were much less important to graduates.

	Very Important	Important
Instructor Office Hours	20	40
Email Correspondence	90	10
Instructor Visits to Remote Sites	50	40
Using the Web for Syllabus, Assignments, Lecture Notes, etc.	56	33
Web Newsgroups, Chat Rooms, List Serves, etc.	13	38
Viewing Most Lectures 'Live'	30	30
Regular, Scheduled Discussions with Instructors (out of class)	10	40
Timely Feedback of Student Work	90	10

Table 4 Distance Learning Environment

Distance Learning Environment- Graduates were asked to input to the times and days that distance learning courses are offered. Three interesting findings resulted:

1. There was almost no support for courses on Saturdays.

2. Most graduates would seriously consider summer courses (currently no courses are broadcast in the summer).

3. Half of the students indicated that early morning courses are preferred.

From the Instructor Perspective- Distance education has at least two instructor learning curves associated with it. Instructors must learn how to teach and interact with remote students, and instructors must learn how to leverage the delivery technology. Instructors attend distance learning workshops prior to teaching in this medium but real learning comes from practice- just doing it, trying new things, and continuously improving. Expecting this learning curve and preparing for it is important. Teaching distance learning courses involves a lot more preparation time and administrative time than teaching standard classroom courses. Since classroom material is transmitted, it must be 'broadcast ready'. This means that instructor notes and diagrams must be legible to a viewing audience. For many, this means having lecture notes written completely prior to class time. Teaching remote students requires more effort than traditional classroom instruction. In particular, sending and receiving materials between the instructor and student requires additional effort. Handing out materials in class doesn't work any longer. Answering urgent questions right after class doesn't work either. The use of mail services, fax, email and the Internet are required. Faculty must use these technologies more extensively for distance learning classes than for other classes. Additionally, faculty must learn how to "broadcast" their lectures for delivery to remote students. This involves learning how to instruct while on camera, utilizing software to increase legibility of slides, and interfacing with remote students during the class. The additional effort in learning and in distance delivery itself, is a concern for many already very busy faculty members. What's in it for the faculty is a serious question that needs to be addressed early in the program-planning phase.

The other learning curve is in the area of the technology. The technology is not failsafe. Interruptions occur with the video and audio components of the delivery system. Learning occurs over time in how to minimize the frequency and duration of interruptions, and how to handle these interruptions when they do occur (while transmitting). Follow-up systems to determine why an interruption occurred and how to prevent it in the future often involves the instructor, which is time the instructor should factor into their planning.

From the Perspective of the Program Administrator- The program administrator (or coordinator) must be knowledgeable about university and departmental policy and procedure. Each remote student is "high maintenance", requiring help in addressing their specific and often unique issues. Examples of the type of issues, which make many students in the program unique, are listed below:

- Applicants that have graduated 10-20 years ago and do not meet graduate school admission requirements require additional effort.

- Applicants who have worked in manufacturing for many years but do not have an engineering undergraduate degree require additional effort.

- Potential students living in geographical areas that do not receive the broadcast signal and want to receive videos of the lecture require additional logistical effort.

- Many students wish to take sub-specialty courses from other universities and transfer the credits into the manufacturing engineering graduate program. Assessing the appropriateness of the courses for graduate study in manufacturing engineering requires additional effort.

- Interfacing from a distance with university administrative systems is difficult for many working students. Admission, course registration, completion of program of studies, scheduling of final defenses, and petitioning for completion of studies all require persistent interface with the university. It is difficult for working professionals to have the time to follow up appropriately during business hours, requiring additional effort.

Summary

We have confirmed through our graduates that many aspects of our first distance learning program are working and are appropriate in this environment. We have also gotten some good feedback for continuous improvement. Although nothing is broken, there are several areas that can be improved. Now that we have these areas identified we are working with our graduates to develop and install specific improvement plans.

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Tom M. West is a Professor Emeritus for the College of Engineering at Oregon State University. He has served the university in the roles of Dean, Department Head and Professor. Tom is recognized as a founding father of the Manufacturing Engineering Masters Program and the Multiple Engineering Cooperative Program at Oregon State University. He is a fellow of the Society of Manufacturing Engineering and the Institute of Industrial Engineering. He has consulting experience with organizations such as Tektronix, Kaiser Aluminum, Reynolds Aluminum, Georgia Pacific, the State of Washington DOT, the U.S. General Services Administration, the University of California Transportation Research Center, and the Forest Service. His fields of specialization are engineering economic analysis, intermodal transportation systems, total quality management, and integrated manufacturing systems.