

# **The MS in Engineering Management at Milwaukee School of Engineering An Update**

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Abstract: At the 1990 ASEE annual conference a paper titled “Evolution and Projections for the MS in Engineering Management” described the experience of the Master of Science in Engineering Management at Milwaukee School of Engineering, one of the oldest graduate engineering management programs in the United States. Since then, the program has faced a number of challenges, including the introduction of the MSEM at Milwaukee’s two largest universities, transition in the local economy including the outsourcing of many manufacturing operations, and perhaps most importantly the clash of diverse viewpoints regarding the focus of the program. This paper analyzes events since 1990 and suggests ways to keep the vision relevant to a changing environment.

## **I. Introduction**

A paper presented at the 1990 ASEE annual conference<sup>1</sup> described the experience of the Master of Science in Engineering Management (MSEM) at Milwaukee School of Engineering (MSOE). The program was one of the first graduate engineering management programs in the United States, and even at that time had gone through periods of both growth and decline. The present paper picks up the story since that time.

The 1990 paper listed four issues then facing the program: (1) the use of technology, particularly the videotaping of classes for later viewing creating a possible conflict between high-tech and high-touch, (2) the teaching of management fundamentals versus current ideas, (3) assuring that growth did not hurt quality, and (4) tensions between the program and the institution. Since then, a major concern has been reversing an enrollment decline and this issue has dominated the other issues.

## **II. A brief description of the MSEM**

Traditionally the MSEM was targeted at engineers and other technically-oriented professionals working in southeast Wisconsin and the Fox Valley (see Figure 1, in which student locations are marked by pins and class locations by circles). Average age of the students is mid-thirties, although ages range from the early twenties to the sixties.

Most students work full time and attend classes in the evenings or on weekends. Reflecting a desire to build on students’ work experience, applicants are required to either have

three years' work experience or be working full time.

In the regular program, shown in Appendix I, students take a total of fifty-one quarter credits. These include twenty-seven credits of required courses, fifteen credits of engineering management electives, and nine credits in one of five specialization tracks (operations, project management, quality, marketing, and organization).

In the specialization track, students take two courses in that specialization and then do a project in that area. Students may substitute a thesis for the specialization track, reducing required credits to forty eight.

In 2003, a required course in research and writing was divided into three one-credit modules. Students are expected to take each module in conjunction with another course, applying the research and writing concepts to papers required by the second course. This change was introduced because of faculty frustration that too often students did not apply concepts of good writing, documentation and research to papers for other courses.

In the fall of 2002, a so-called "accelerated" program was introduced. In this program, courses are organized into "suites" of three courses. The suites meet for four hours ever Wednesday evening and all day on alternative Saturdays. Appendix II summarizes the accelerated program.

While courses in the suites have the same expectations and rigor as their regular equivalents, they are designed to be blended, reducing the total class time somewhat compared to three regular classes. Assignments may serve several courses. For example, students in the second suite may design an organizational behavior survey and statistically analyze the results, allowing one project to apply to both courses.

Despite this blending, the accelerated program is very intense. Some students switch from the accelerated program to the regular program when the pressure becomes too great. (A few students have also switched from the regular to the accelerated program.)

For many years, faculty in the MSEM have been a mix of practitioners and full time. Despite the widespread belief in academia about lack of commitment among part-time faculty, the MSEM part-timers have played a major role in setting the direction of the program over the years. Students regularly express their appreciation for the practical experience of the faculty.

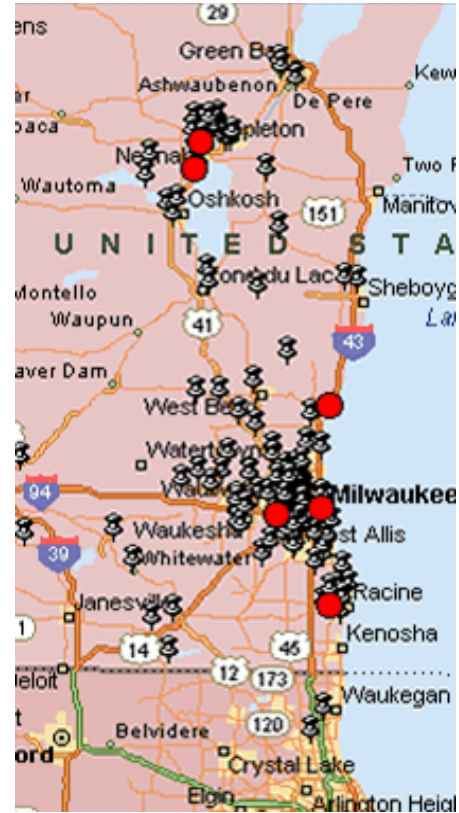
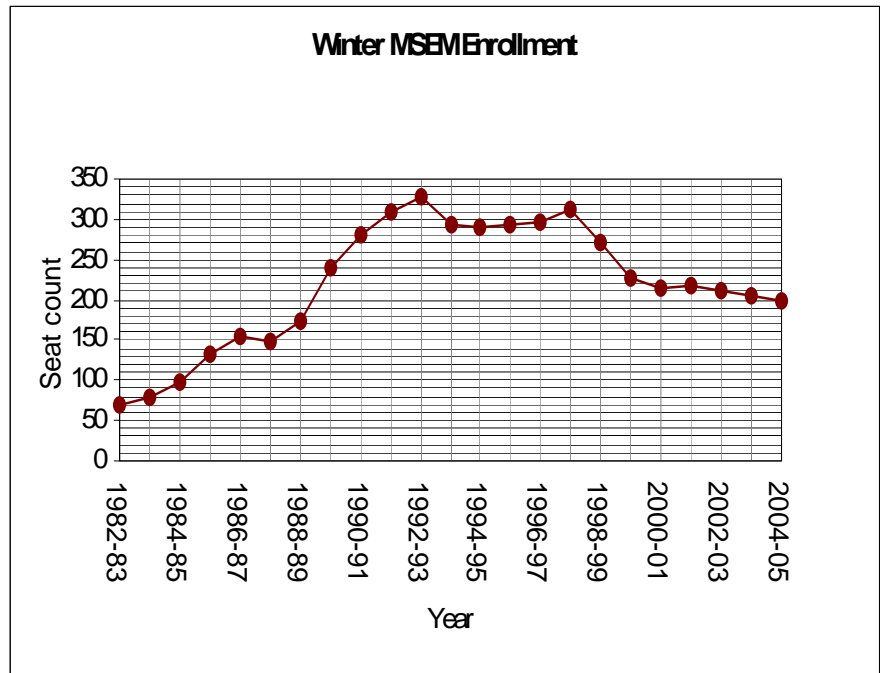


Figure 1. Students and classes

### III. Enrollment history

The 1990 paper expressed confidence about future enrollment growth, citing three factors: (1) strong word of mouth among students who encouraged colleagues to enroll, (2) apparent under-promotion of the program suggesting that the market was not yet saturated, and (3) the potential for expansion of the program to additional sites around Wisconsin.



**Figure 2.** Enrollment over time

However, as Figure 2 shows, the earlier optimism about enrollment has not been borne out in practice. Since the early 1990's enrollment has dropped from a peak of more than 300 to about 200 this past winter. The decline seems to have leveled off recently, but has left the program overextended: too many classes in too many locations, leading either to cancellations or uneconomical class sizes.

Currently efforts are being made to bring the number of classes into line with the enrollment. For example, one location was recently dropped after encountering a series of class cancellations and finding that when classes ran they were generally filled with students traveling from other locations.

Possible causes for the decline include increased competition, changes in the local economy, and internal missteps.

#### A. Competition

The earlier paper largely regarded competition as that from traditional MBA programs. While that competition continues, two other groups of players have entered since: MSEM programs offered by other universities and the recent growth of accelerated management degree programs.

## 1. Other MSEM Programs

Shortly after the 1990 report, the two largest universities in Milwaukee introduced their own Master of Science in Engineering Management programs. Both were joint efforts between the universities' business and engineering schools. Students in these programs were required to take a mix of engineering and management courses.

The new programs have not enjoyed great success. One is "currently suspended for reevaluation." A co-director of the other estimates enrollment to be in the mid-twenties. It seems likely that the lack of greater success reflects both organizational and programmatic causes.

From an organizational viewpoint, as joint ventures, the programs appear to be institutional orphans with neither school heavily invested in their success. It was even difficult to identify who was in charge of them. The web biography of the business co-director at the second university, for example, lists many interests, but not the MSEM. At this same university, students may have to take engineering courses during the day, discouraging working professionals.

A second likely contributor to low enrollment in those two programs is that many potential students may not desire a mix of engineering and management courses. In our experience, the typical candidate already has a strong technical background—through education, work or both—but needs much more in the management area. Traditional universities have trouble duplicating MSOE's program because of internal rivalries between business and engineering. Thus it is likely that many students attracted to the MSEM at one of those universities end up choosing that institution's MBA instead.

Therefore, it seems unlikely that competition from the other two MSEM programs has had a major impact on enrollment in MSOE's MSEM. If anything, a case could be made that the introduction of these programs adds credibility to the MSEM degree.

## 2. Accelerated Programs

In recent years, programs offering fast management degrees have exploded in numbers. These programs share a number of advantages that historically made the MSEM attractive for the working engineer: convenient scheduling, a largely practitioner faculty, and the assurance offered by institutional accreditation. But in addition, they allow the student to obtain a degree much more quickly than do more traditional programs like MSOE's MSEM.

Course titles and requirements in accelerated programs are typically modeled on the traditional MBA. For example, Appendix III compares the courses taken in a local traditional MBA with those of one of the most-promoted accelerated MBA's. As can be seen, a casual observer would be hard-pressed to identify major differences.

The reason for comparing the accelerated MBA with a traditional MBA, rather than with the MSEM itself, is that a comparison with the MSEM confounds two sets of differences: those due to acceleration and those due to distinct course offerings. The particular traditional MBA shown was chosen because it demands about the same level of effort and time commitment as the MSEM.

Yet a comparison using credits obscures the difference in time and effort demanded. Classes in the traditional program meet for sixteen weeks, while those in the accelerated program are six to eight weeks long. Even allowing for slightly longer class periods, students in the accelerated program spend about half as much class time. Thus while the credit hours appear similar, the total class time put into the accelerated program is substantially less.

Defenders of accelerated programs often point to use of technology, standardization of curricula, and quality control over faculty as factors that compensate for decreased time. The implication is that greater effectiveness and efficiency and better focus allow an equivalent program in much less time. And it certainly makes sense that more time, if spent poorly, may not result in more learning.

Despite the growth of these programs and the pressure they put on traditional education, the lack of research on their outcomes is striking. The number of articles about the University of Phoenix—the largest player in the accelerated market—is very limited. Those available largely concentrate on two other issues: whether it is appropriate for a profit-making company to offer college degrees and Phoenix's association with on-line education. Yet in recent years, on-line education has decreased as a fraction of Phoenix enrollment, as Phoenix has established classrooms around the country. Nor are accelerated programs limited to for-profit companies. In fact, the program summarized in Appendix III comes from a non-profit university that has been part of the local scene for decades.

Part of the explanation for the lack of research certainly rests on the difficulty of getting comparative information on outcomes. There are no widely-recognized or standardized outcome measures for most university programs—and certainly not for management education. One reason that ratings of college programs published by magazines concentrate on input measures is that output measures are so hard to find.<sup>2</sup> If anything, the lack of agreed-upon outcome measures is even worse at the graduate level.

Recent experience with incoming MSEM students sheds intriguing light on the question of relative outcomes. In a recent class, six students were graduates of accelerated programs and seventeen of conventional programs.<sup>3</sup> As can be seen in Table 1, the accelerated program graduates earned substantially lower grades than those graduating from conventional programs. Although the example was small, the difference was statistically significant at the 99% confidence level.

The result is certainly not conclusive about accelerated graduate program outcomes.

First, it reflects undergraduate accelerated programs—not those for graduate students. Second, the sample size is small—although that size is reflected in calculating significance. Most importantly, the sample is self-selected, not random. The six all were taking their first dose of the “accelerated” MSEM program and may have expected, because of the name, something much closer to what they had experienced as undergraduates. Thus the results could reflect mis-aligned expectations as well as deficiency in preparation.

**Table 1. Grade Comparison**

t-Test: Two-Sample Assuming Equal Variances

	<i>Accel</i>	<i>Other</i>
Mean	2.167	3.559
Variance	0.667	0.590
Observations	6	17
Pooled Variance	0.608	
df	21	
t Stat	-3.759	
P(T<=t) one-tail	0.00058	

This expectation problem may have been captured by the comments of a student who dropped out of the MSEM after the first class. A graduate of an accelerated program but not included in the sample in Table 1, this student complained that with the number of assignments it was impossible to do them in depth:

Finding a balance between a full-time managerial job, family obligations, and graduate school was extremely stressful. I understood the program to be geared to the working manager. Less deliverables. More content and quality expectations should be the direction of the program....Overall, I didn't feel the content was difficult. Just too time consuming. If the students are able to complete all of the deliverables, I can assure you 100% effort on each assignment is not given. With the short time I spent with my class, I could easily sense this.....I have a high degree of academic integrity. I could have "skated" through the program and done sub-standard work. That's not me. I felt that If I could not consistently perform at a high level, I would have only hurt myself.

Still, the results suggest that less time means less substance, and that more research is needed on the effectiveness of accelerated programs. At the very least, it suggests that more should be done by MSOE to explain both to potential students and to their employers the benefits of the extra commitment needed to complete the MSEM. It is likely that the MSEM will never be able to compete with such programs for the student solely concerned about getting needed credentials as quickly as possible, such as someone told that the lack of a degree is all that is preventing a promotion. But there is a need to show the others that the extra time and effort is worthwhile.

**B. Changes in the economy**

Southeastern Wisconsin and the Fox Valley traditionally have had a high concentration of manufacturing, leaving them particularly vulnerable to recent changes in the economy as

global competition heated up. Plants closed or moved overseas, work has been outsourced, and old industrial buildings are being converted to condominiums. Companies that once employed hundreds of engineers are now gone or a shadow of their former selves.

These changes have been particularly disruptive to the target audience for the MSEM. Most students work for organizations serving a wide national or global market, rather than the local region. They are particularly vulnerable to global competition, even if the local economy as a whole remains healthy.

The question remains whether the changes reflect a permanent reduction in the importance of the part of the economy served by the MSEM—or a temporary disruption, as weak players dependent on low labor cost leave but are replaced by newer firms. Even if the latter, the changes could disrupt MSEM enrollment. A large fraction of students has traditionally been recruited by word of mouth, usually from co-workers. If new companies are not identified, visited, and recruited, there will be a natural attrition over time, even with no net decrease in the market.

While the long-term success of the MSEM depends on the success of the local technology-rich economy, it could also be argued that the success of the economy depends on the success of the MSEM. As activities dependent on low labor costs leave, the competitive importance of flexibility and good strategic thinking will grow among those remaining. Having a core of people who think in both technological and management terms becomes even more important to success in this environment.

### C. Program missteps

As with any organization, some of the decisions made over a period turned out to be counter-productive. Three mentioned here are changes in thesis requirements, over-committing to locations away from the main campus, and dropping company visits .

Traditionally all MSEM students were required to write a thesis applying the concepts in the program. While graduates of the program often commented on the value they found in the thesis, it had become a major barrier to graduation. Many students who had satisfied the course requirements did not have the degree because of the thesis. This problem was converted to a crisis in the 1990's by two decisions. The first was a campaign to model thesis requirements on those typical of programs aimed at preparing their students for a career in academic research and teaching. The second was a policy prohibiting academic credit for paid work, eliminating theses based on issues at the student's employer. Students came to regard the thesis as an unscalable barrier. The employer of the largest number of students threatened to stop supporting the program upon discovering that none of its employees had graduated in the previous few years.

A number of steps were taken to restart student progress. A course to assist students in starting the thesis was introduced. The policy against employer-focused topics was reversed.

Thesis guidelines were better defined. Students were given the option of writing a project instead of the thesis. As a result, the number of students graduating has greatly increased. However, some suspicion of the MSEM probably lingers from this period.

Another self-inflicted wound resulted from efforts to expand the program by offering it in more locations. In some cases, there was either too small a population of potential students or too little effort to promote it. As a result, the program in several of these locations struggled for sufficient enrollment to make classes viable. The resulting course cancellations led to recurring rumors of impending abandonment of the MSEM by Milwaukee School of Engineering. These rumors were further fed by an institutional decision to phase out most undergraduate programs in the Fox Valley.

A third factor contributing to the enrollment decline was decreased emphasis on visits to companies. In previous years, there was often a clear connection between an open house at a company and subsequent enrollment by employees of that company. The effect seems to be double-pronged: direct communication to potential students and an implicit stamp of approval by the employer. These visits largely stopped as admissions personnel were assigned to other duties.

#### IV. Responding to the Challenge

##### A. The Faculty Marketing Committee

Several of the members of the MSEM faculty work full-time in marketing-related positions while teaching part-time. In response to enrollment challenges, they formed a marketing committee to look at ways to better communicate the program's benefits to potential students. The committee examined surveys of students and graduates, finding a high level of satisfaction.

As with any educational program, improvements could be made. For example, a session of industry representatives focusing on continuous improvement came up with a number of suggestions. One was making project management required for all students. Another was to make sure that fundamental management skills were taught and practice throughout the program. But survey results do not suggest that any change to the program would have a measurable effect on enrollment.

Members of the marketing committee also developed a short publication that talked about the benefits of the MSEM for students. This piece has since been used as a model by other programs at MSOE.

The committee is currently exploring ways to identify employers of technically oriented people who would be potential students in the program. Once identified, events such as breakfast meetings with groups of managers in these firms can be planned.



## B. Focusing the Vision

The program has always suffered from an identity problem. Despite the name, it is not a combination of engineering and management. Nor is it limited to those whose interest is the management of engineering departments. While the MSEM is a management degree, it is one tailored to the needs of its technical audience.

The program's title has engendered recurrent discussion among both faculty and students. Taken literally, the present name is overly restrictive, implying that graduates all manage engineering departments. However, finding another term that adequately encompasses the program is not easy.

One set of suggestions stresses the management and leadership side of the program. When asked, some students say such a change would be helpful. Others, however, report that within their organizations it is easier to get tuition support for engineering management than degrees with more general management titles. The present title sometimes triggers interest among some potential students, partially compensating for the lack of targeted promotional efforts. A more generic management degree would lose this advantage.

Another suggestion is to emphasize the management of technology. Yet this too is overly restrictive. The management of technology is only one of many things graduates of the MSEM do.

Related to program identity is the issue of whether to seek accreditation. The lack of accreditation creates concern among some potential students and companies, but allows flexibility to tailor the program to their needs. The MSEM is not an MBA, and requires a different set of courses than the standard MBA. If accredited as an MBA, the program could lose that focus. Also the MBA favors business graduates in its admissions. Accreditation through ABET as an MSEM would appear to limit admission to engineers who graduate from accredited engineering programs, essentially treating the MSEM as a variety of engineering program.

Recently the faculty developed a vision statement to better capture the essence of the MSEM:

The success of organizations competing in a fast-changing technology-driven global environment depends upon employees who are able to think and apply innovations both technically and strategically. The MSEM is focused on developing the management skills that people working in technical environments need to effectively lead the intersection of technology and management. The best measure of our success is our graduates' contributions to the organizations they work for and the leadership they offer to their industry and community.

Core competencies of MSOE's MSEM include an experienced faculty, particularly with

management and technology, and encouraging students to apply concepts to their organization.

Rather than trying to find a name and identity that satisfies all constituencies, it may be more productive to develop new programs that draw on the MSEM's strengths while broadening the appeal.

For example, many of the present students work in new product development, generally on products with an engineering emphasis. For these students the MSEM is essentially an MS in New Product Development. It seems likely there are other potential students working in new product development but without an engineering background who would benefit from the same set of courses but are put off by the engineering management title. At a local consumer products company, for example, product developers are more likely to have backgrounds in biology, chemistry, entomology, or marketing than engineering. Thus a degree in new product development might serve to open new markets.

Likewise, some of the other specialties embedded in the MSEM, such as project management, quality, operations, and industrial marketing might have a broader appeal to non-engineers working in these areas.

## V. Discussion and Implications

Within MSOE, there is disagreement as to the causes of the enrollment decline and what can be done to reverse it. Some university administrators point to factors outside MSOE's control. One is changes in the Wisconsin economy, leading to the exit of a number of manufacturers and among those remaining a tightening of tuition reimbursement programs. Another is the growth of competition, particularly those promising a master's in half the time and with half the effort of the MSEM.

Most of the MSEM faculty, and many students, have expressed the view that the decline is largely self-inflicted. They believe that the program has not been effectively marketed, resulting in many potential students who could benefit but are not aware of it.

Truth probably lies somewhere in between: changes in the economy coupled with greater competition have had a major effect which has been exacerbated by the lack of effective response. Too little has been done to identify and cultivate the companies that are growing, replacing those in decline or moving out. And too little has been done to effectively demonstrate that the extra time and effort required for the MSEM creates an offsetting value for students and their employers compared to faster programs.

Appendix I. Master of Science in Engineering Management (MSEM)

		Quarter Credits	
		Thesis	Project
EM-600	Management Principles	3	3
EM-631	Research and Writing (Module 1)	1	1
EM-610	The Application of Statistics	3	3
EM-632	Research and Writing (Module 2)	1	1
EM-620	Finance and Accounting	3	3
EM-633	Research and Writing (Module 3)	1	1
EM-640	Operations Management	3	3
EM-650	Managing Information Systems	3	3
EM-660	Applied Organizational Behavior	3	3
EM-670	Marketing Management	3	3
EM-800	Strategic Management	3	3
EM-xxx	Engineering management electives	15	15
EM-804	Thesis	6	
EM-xxx	Specialization Track Electives		6
EM-8XX	Project		3
Total Credits		48	51

## Appendix II. Accelerated Master of Science in Engineering Management

Project Management Suite		EMS-1
EM-620	Project Management Finance and Accounting	
EM-765	Leading Project Teams	
EM-795	Managing and Implementing Projects	
EM-631	Research and Writing (Module 1)	

Management Principles Suite		EMS-2
EM-600	Management Principles	
EM-610	The Application of Statistics	
EM-660	Applied Organizational Behavior	
EM-632	Research and Writing (Module 2)	

Contemporary Operations Integration Suite		EMS-3
EM-640	Operations Management	
EM-650	Managing Information Systems	
EM-670	Marketing Management	
EM-633	Research and Writing (Module 3)	

Strategic Leadership Suite		EMS-4
EM-745	Strategic Technology Management	
EM-744	Supply Chain Management	
EM-800	Strategic Management	

Application of Business Solutions Suite		EMS-5
EM-708	Executive Management Simulation	
EM-746	Quality Management and Engineering	
EM-768	Human Resource Management	

EM-807	Management Solutions	
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TOTAL PROGRAM CREDITS		51
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Appendix III. Comparison of Traditional MBA and Accelerated MBA

Traditional MBA		Accelerated MBA	
Foundation Courses	Credits	Prerequisites	Credits
Economics Foundations	2	Microeconomics	3
Accounting Foundations	2	Accounting I: Financial Accounting	3
Mathematics Foundations	2	Managerial Finance	3
Statistics Foundations	2	Statistics I	3
<i>Total</i>	8	<i>Total</i>	12
Graduate Courses			
Managerial Accounting	3	Advanced Managerial Accounting	3
Managerial Economics	3	Advanced Managerial Economics	3
Financial Management	3	Advanced Managerial Finance	3
Marketing Management	3	Advanced Marketing Management	3
Organizational Behavior	3	Human Relations and Organizational Behavior	3
Quant. Dec. Methods	3	Quantitative Analysis for Management	3
Information Tech Management	3	Fundamentals of Executive Management	3
Global Envir. Business	3	Legal and Ethical Issues for Managers	3
	3	Statistical Methods II	3
Skills Course	1	Human Resource Strategies	3
Operations and Supply Chain Management	3	Operations and Production Management	3
Elective	3	Capstone: Global Business Policy and Strategy	3
Elective	3		
<i>Total credits</i>	37	<i>Total credits</i>	36
<i>Total class hours</i>	592	<i>Total class hours</i>	356

## Notes

1. Thompson, Bruce R. (1990), Evolution of and projections for the MS in Engineering Management. Proceedings, ASEE Annual Conference (Toronto).
2. Thompson, Bruce R. (2004), A value-added perspective on the college ratings, Proceedings, ASEE Annual Conference (Salt Lake City).
3. Two students were not included because it was not clear how their programs should be classified. The accelerated programs were University of Phoenix, Cardinal Stritch, and ITT Technical Institute. Those classified as conventional programs were from MSOE and state universities (many branches of the University of Wisconsin, but also some from other states). The course was in two sections, one accelerated, the other regular, taught by the same professor using the same tests and assignments. The six graduates of accelerated undergraduate programs were all in the accelerated section of the MSEM. Among graduates of conventional programs, there was no significant difference between students enrolling in the two sections.

## Biography

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