

## **A Technology Curriculum for the Year 2000 and Beyond Minor in Management Program for Technology**

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### **Abstract**

Whether it be in Industry or in the Service sector, today's Technology graduates are developing, implementing, and maintaining systems that are the foundations of the American economy. So, what is next for these individuals who understand the technical aspects, but not necessarily the economic ramifications?

Companies have realized the benefits of Technology graduates as front-line supervisors, trainers, plant engineers, maintenance technicians, and simply "jacks-of-all-trades". They are being asked to provide economic analyses for projects, supervise employees, manage projects, and provide basic financial data. But, are these graduates well-prepared to face these assignments? Companies actively promote Technologists who have both managerial and technical competencies into technical management positions.

A curriculum being developed at Purdue University Calumet (PUC) by the Electrical Engineering Technology (EET) Department proposes to incorporate a Minor offered by the School of Management in its' Bachelor's Degree in Electrical Engineering Technology to provide their graduates with essential management skills required in today's workplace. With these practical tools "in-hand" as well as their "hands-on" education, EET graduates will find more opportunities available in areas outside the mainstream of technical occupations. Ultimately, this combination of skills will provide EET graduates with an effective track for career advancement.

This paper will discuss the curriculum details necessary to achieving these objectives.

## I. Introduction

A primary goal of higher education focuses on the development of marketable skills that will provide graduates the most opportunity and flexibility in career choice and future advancement opportunities. With this in mind, a curriculum being developed by the Electrical Engineering Technology Department at Purdue University Calumet proposes to incorporate a Minor in Management in its' Bachelors degree program. This goal can be accomplished within the framework of the existing TAC/ABET approved curriculum.

Formal and informal studies have revealed a need for additional skills in managerial science for technology graduates. The EET Department consulted with alumni, its' Industrial Advisory Committee (IAC), and the Department of Management for input in developing the Minor in Management option. The IAC includes members from diverse organizations such as Lucent Technologies, Northern Indiana Power Supply Company (NIPSCO), Federal Signal Corporation, Saint Margaret Hospital, LTV Steel Company, Northern Telecom, and Commonwealth Edison, to name a few. The Committee identified the following proficiencies they believe are necessary in order for technology graduates to succeed and advance effectively in their careers.

- An understanding of a company's overall strategies and objectives
- Effective functioning in teams and groups
- Financial management techniques including costs analysis and cost control
- Project management functions such as planning, scheduling, and monitoring
- Strong technical report writing capabilities
- Strong verbal communication skills
- Knowledge in quality control, including ISO, and Total Quality Management principles

Alumni surveys confirm the above requirements for career advancement. The EET department is consulting with the Department of Management for its input in developing a Minor program that will fit within the existing framework of the EET plan of study.

## II. Benefits of a Management Minor for a Technologist from a Business Perspective

The incorporation of a Minor in Management into a Bachelor's program is not a new concept. Programs in Liberal Arts often include courses in management. This is partially due to the fact that topics such as writing, speech, and foreign language are directly applicable in business fields. Another reason why a Minor in Management option is popular in Liberal Arts is that the program provides a sufficient number of elective hours outside of the plan of study to easily accommodate the Minor within the curriculum.

On the other hand, TAC/ABET approved Technology programs offer a limited number of elective hours that can be taken outside of the major plan of study. Thus, Technology schools must devise more creative approaches to incorporating a Management Minor into their curricula.

For instance, in 1995 The College of Staten Island/CUNY implemented a Management Engineering Technology Bachelor's degree. It is an add-on degree designed to provide current undergraduates and previous graduates of two year TAC/ABET accredited engineering technology programs with an understanding of business and management concepts. An alumni survey at the College found that 65% of their two year technology graduates would continue on with a B.S. degree if the management in technology program was offered <sup>1</sup>.

Since 1982, Brigham Young University has had considerable success with its program known as the Master of Technology Management. Though it is not a Bachelor's program, it does afford the Technology graduate the opportunity to gain business and managerial skills in addition to advanced technical training. Their data shows that enrollment tripled from 13 to 40 people in a five year period (1989 - 1993) <sup>2</sup>.

Schools such as MIT, Northwestern, and University of Pennsylvania/Wharton School of Business are known for Technical Management graduate programs. University of Pennsylvania/Wharton School of Business also has an undergraduate dual degree program in Engineering and Business.

The coming era is one that will be characterized by intense global competition across all commerce. Every business will be a technology business in the sense that technical innovations will either be used or developed. The success of any organization will be determined by its ability to adapt to these changes and unlock the potential to a variety of emerging technologies.

Key requirements for business survival in this highly competitive environment include: hiring and retaining employees who exhibit managerial and technical expertise; actively pursuing a commitment to quality of product, process, and service; understanding the global economy and issues surrounding workforce diversity; and recruiting employees who can effectively communicate and contribute in cross-functional teams.

Analysis in various industries reaffirm these conclusions. A study of textile and clothing manufacturers in Greece indicated that strong technical and managerial competencies were required for middle managers. This is due largely to the fact that production departments in the industry have become highly integrated. Technical managers should have the capacity to solve a variety of process problems, have the ability to calculate production costs, find ways of improving efficiency, and have knowledge in financial administration, marketing, and overall organizational strategy <sup>3</sup>.

Practicing technologists in the United States have also indicated their need for business skills. The University of North Carolina at Charlotte conducted surveys over a seven year period which analyzed responses by technology graduates regarding the competencies they wish to master by graduation in order to compete in the global marketplace. The following was documented:

- Within 3-5 years after graduation, many graduate engineering technologists discover that their bachelor degree preparation in technology propelled them into areas of responsibility **that require competencies not developed in the undergraduate program.**

- A high percentage of graduates move into management positions **that require more people skills**.
- Their ability to compete in the global oriented business environment was **limited because of deficient competencies in key business areas** <sup>4</sup> .

At Purdue University Calumet, an analysis of EET job placement data reveals that graduates require not only technical aptitude, they also require leadership abilities, communication skills, and a level of business acumen. The following list identifies positions that EET graduates are being hired for, most of which require a broader level of understanding beyond basic technical skills.

- Technical Buyer
- Systems Analyst
- Management Consultant
- Computer System Applications
- Electrical/Electronics Technician
- Electrical/Electronics Salesperson
- Hardware/Software Engineer
- Biomedical/Clinical Engineer
- Telecommunications/Wireless Engineering Technicians
- Field Service Technician
- Motor Inspector

### III. Management Requirements for Technology Minor Option

In order to develop a reasonable overview of business concepts applied in today's workplace, a student outside of the Management program must take courses in four core subject areas : finance, marketing, operations, and organizational/human resource management.

Each topic serves to broaden a student's understanding in various aspects of an organization. For instance, a technologist should understand underlying concepts regarding costs-to-benefits when implementing a technical project. It is also necessary to have a basic knowledge on the interdependent nature of the economy and how it affects global competition and decision-making. An understanding of marketing concepts will benefit a technologist in cross-functional teamwork and in technical sales. Organizational behavior topics emphasize effective communication, teamwork, and the importance of valuing diversity. Lastly, technologists must understand total quality commitment issues and production principles which are emphasized in operations management topics.

The objectives of the Minor in Management for the EET Bachelors' degree program are to provide graduates :

- The required skills to perform effectively in today's corporate environment.
- A broader scope of opportunity in traditional and non-traditional fields.

- Access to an accelerated path for career advancement. By learning core managerial and communication skills early in their careers, Technologists are afforded opportunities to advance into technical management sooner. They will not need to spend several years “gaining experience” on the job.
- Basic management competencies that will allow Technology graduates to advance into MBA programs after taking only a minimal number of prerequisites.

#### IV. Curriculum Set-up

The Occupational Outlook Handbook projects that employment growth for Engineering Technologists between 1994 - 2005 will be approximately 5 - 10%. It also describes general job functions of Engineering Technicians, including :

- Utilize principles and theories of science, engineering, and mathematics to solve technical problems in manufacturing, sales, customer service, research and development, and construction
- Supervise production workers and study ways to improve manufacturing efficiency
- Aide in the planning and building of construction projects as well as estimating costs and specifying materials
- Design and develop electronic equipment such as radar, control devices, and computers
- Support testing of machinery, robotics, materials, and computer systems
- Plan production by documenting process information, estimating labor costs, and providing technical data<sup>5</sup>

These technical competencies should be supplemented with business skills in order for the technologist to be effective and ultimately advance into a managerial position.

PUC offers a two-plus-two degree program in Architectural Engineering Technology, Construction Engineering Technology, Electrical Engineering Technology, Mechanical Engineering Technology, Manufacturing Engineering Technology, Industrial Engineering Technology. All programs are accredited by TAC/ABET. At this time, the proposed Minor in Management is specific to the B.S. in Electrical Engineering Technology. The A.S. program requires 67-70 credit hours, and the B.S. requires 128-130 credit hours for graduation. A Minor in Management requires 24 credit hours. The Management requirement will also provide the necessary prerequisites for an additional advanced degree such as an MBA. The curriculum is designed to achieve the above requirements in four years of full-time study.

**Table 1** shows the distribution of Management courses within the EET plan of study.

**TABLE 1**  
**Incorporation of A Minor in Management into the EET Bachelor's Plan of Study**

	<u>Open Slots in EET Plan of Study</u>	<u>Credit Hours</u>	<u>Required Course</u>	<u>Course Title</u>
1	Humanities/Social Science Elective	3	ECON 251	Micro Economics
2	Science/Mathematics Elective	3	MGMT 225	Managerial Statistics
3	Technical Elective	3	MGMT 200	Introductory Accounting
4	Technical Elective	3	MGMT 201	Managerial Accounting
5	<i>Summer Session **</i>	3	MGMT 310	Financial Management
6	Humanities/Social Science Elective	3	OBHR 330	Organizational Behavior
7	<i>Summer Session **</i>	3	MGMT 324	Marketing Management
8	Free Elective	3	MGMT 360	Operations Management
	<b>Total</b>	<b>24</b>		

\*\* Two courses, Financial Management and Marketing Management, can be completed during summer sessions. These courses are not within the BS in EET plan of study.

The Technology graduate will also complete six credit hours of writing (composition, business/technical report writing), six hours of speech communication, and six hours of humanities/social science. In addition, students will be encouraged to take a business ethics course in a Humanities elective slot. The current EET Bachelor's degree program requires 128-130 credit hours to complete. By scheduling several of the Management courses within the existing framework, the number of credit hours needed for the proposed Bachelor of Science degree with a Minor in Management will be between 134-136 credit hours.

The Minor in Management option provides EET students the opportunity to effectively advance into MBA programs. With the addition of Macroeconomics and Strategic Management courses, the proposed Minor will provide the background necessary to waive the "foundation courses" typically required in an MBA program.

The proposed curriculum includes all components of knowledge of technical subjects, mathematics, science, writing and speech communications, and managerial skills for the graduates to enter a career and advance into managerial positions.

## V. Conclusion

The proposed Management Minor in the EET program will provide students with strong technical skills and a broad educational background that includes a number of business courses within a TAC/ABET approved program. The objective of the proposed curriculum is to provide the necessary skills required to perform effectively in today's corporate environment. Another goal is to prepare students for advancement into technical management positions. The enhanced

Technology degree will also broaden the scope of employment opportunities for graduates in traditional and non-traditional fields.

At this time, the incorporation of a Minor in Management in the EET Bachelors' program has been introduced in the curriculum development process.

The proposed plan of study offers a win-win situation for technology graduates and employers, as well as the Electrical Engineering Technology program and Management program at Purdue University Calumet.

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### Biographical Information

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#### SHOMIR SIL

**Shomir Sil** is the Head of the School of Management at Purdue University Calumet. He received his B.S. in Mechanical Engineering from Hyderabad, India in 1972 and an M.B.A. from Indian Institute of Management in Calcutta, India in 1974. He received his Ph.D. in Finance from Texas Tech University in 1983. Prior to joining Purdue, he ran his own engineering consulting firm for over 10 years, which specialized in designing and manufacturing pneumatic and hydraulic instruments.

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**Chandra Sekhar** is the Head of the School of Electrical Engineering Technology at Purdue University Calumet. He received his B.S. in Chemistry from The University of Madras, India in 1958, a D.M.I.T. from Madras Institute of Technology, India in 1961, and an M.S. in Electrical Engineering from University of Pennsylvania in 1963. His interests are in Biomedical Instrumentation and Technology. Prior to joining Purdue, he was the Director of Biomedical Engineering at Michael Reese Hospital in Chicago, IL. for over 15 years.