AC 2007-1156: ENGINEERING MANAGEMENT AND INDUSTRIAL ENGINEERING: SIMILARITIES AND DIFFERENCES

Cassandra Elrod, University of Missouri

Cassandra C. Elrod is doctoral student in the Engineering Management and Systems Engineering department at the University of Missouri – Rolla. She holds a Bachelors degree in Engineering Management with an emphasis in Management of Technology (2003), and a Master's degree in Engineering Management (2004), both from UMR. Her research interests include learning styles, engineering education, and organizational behavior issues.

Ashley Rasnic, University of Missouri

Ashley Rasnic is an undergraduate student in the Engineering Management and Systems Engineering department at the University of Missouri – Rolla. She is currently working on her Bachelors degree in Engineering Management with an emphasis in Industrial Engineering.

William Daughton, University of Missouri

Dr. William Daughton is professor and chair of the Engineering Management and Systems Engineering department at the University of Missouri-Rolla. He has significant industrial management experience in the semiconductor industry and over 15 years of teaching experience.

Engineering Management and Industrial Engineering: Similarities and Differences

Abstract

Engineering Management is a broad and diverse field of engineering, thereby making it difficult to define exactly what the degree encompasses. At the same time, the somewhat related degree of Industrial Engineering is better understood. Some universities offer a Bachelor of Science degree in Engineering Management with an emphasis in Industrial Engineering, while others offer a Bachelor of Science degree in Industrial Engineering with an emphasis in Engineering Management. In today's world of competitive academia, many wonder if these degree fields are similar enough to be used interchangeably or if there is a distinct difference separating the two degrees, making it mandatory that they stay clearly separate. To be able to offer insight into these concerns, a study of academic departments will be conducted to determine how both fields are defined and what real similarities and differences exist. As part of this study, curricula from departments in both fields will also be compared to better understand the similarities and differences in these degree programs in regard to course requirements. The results of this study will be provide insight into differentiating characteristics of the engineering management degree as an aid to successfully marketing it to prospective students.

Introduction

Engineering Management is a broad and diverse field of engineering, thereby making it difficult to define exactly what the degree encompasses, with differences occurring even between degree levels. Anecdotal evidence suggests that the somewhat related degree of Industrial Engineering is better understood than the degree of Engineering Management[1]. Since these two fields seem to be closely related, it is not surprising to find some higher education institutions offering each of the degree programs or offering one degree program with an emphasis in the other. For example, some institutions offer a Bachelor of Science (B.S.) degree in Engineering Management with an emphasis in Industrial Engineering (University of Missouri – Rolla), while others offer a Bachelor of Science degree in Industrial Engineering with an emphasis in Engineering Management (University of Wisconsin - Platteville). In today's world of competitive academia, many wonder if these degree fields are similar enough to be used interchangeably or if there is a distinct difference separating the two degrees, making it important to clearly differentiate them.

In order to offer insight into these concerns, departments within higher education institutions offering these two degree fields will be studied to determine how both fields are defined, and what evident similarities and differences exist between them. As part of this study, curricula from departments in both fields will also be compared to better understand the similarities and differences in these degree programs in regard to course requirements. Also, in order to better market the degree field of Engineering Management, this study hopes to draw conclusions about what the common definitions/elements are so that the field can be marketed consistently to both perspective students and potential employers.

Methodology

In order to make comparisons between the Engineering Management and Industrial Engineering degree fields' definitions and curriculum, a decision on what institutions and programs to include had to be made. For the degree of Bachelor of Science in Engineering Management, only schools that held an ABET[2] accreditation in Engineering Management (not combined or mixed programs) were selected to be analyzed. These schools were thought to be most closely comparable since the ABET holds each school to the same standards. Combined discipline programs were not included in this study to eliminate confusion in identifying the similarities and differences between Engineering Management and Industrial Engineering programs. The five schools with an accredited Engineering Management B.S. degree are as follows:

- University of Missouri – Rolla (UMR)
- Stevens Institute of Technology (Stevens)
- University of Arizona (Arizona)
- University of the Pacific (Pacific)
- United States Military Academy (West Point)

To provide insight into the different marketing strategies and program offerings between the Engineering Management and Industrial Engineering degrees, nine institutions offering Industrial Engineering degrees were selected as representative of the Industrial Engineering program. These schools were chosen based on their ranking in the 2007 U.S. New & World Report Best College[3] list (in which the top rankings are free to the public), as well as their ABET accreditation. Three of the schools chosen ranked as the top Industrial Engineering schools offering a B.S. degree, the next three schools were chosen based on their tie for the #4 top Industrial Engineering school offering a B.S. or M.S. degree, and the remaining three schools ranked as the top Industrial Engineering schools offering a PhD degree. These schools were chosen to represent all types of programs and schools offering the Industrial Engineering degree, since there are approximately 95 schools offering a B.S.I.E. degree which is accredited by ABET. Using ABET accreditation alone as a method of choosing which schools to represent definitions and curriculum for the Industrial Engineering degree would not have been sufficient. Therefore, the following schools were chosen for comparison at the Bachelor's level:

- Georgia Institute of Technology
- Purdue University
- University of Michigan – Ann Arbor
- Kettering University
- Bradley University
- Cal-Poly – San Luis Obispo
- Cal-Poly – Pomona
- Milwaukee School of Engineering
- University of Wisconsin – Platteville

Finally, a comparison between B.S. and M.S. degrees in Engineering Management was made by using a set of institutions that offer an M.S.E.M. degree exclusively. The programs at these institutions were compared to the five ABET accredited programs offering a B.S.E.M. The

selection of these schools was based off of an internal report from the Engineering Management Department at the University of Missouri – Rolla which listed the top Engineering Management schools based on number of graduates.[4] The following schools were chosen from that report:

- George Washington University
- Old Dominion University
- Florida International University
- University of Michigan - Dearborn
- Southern Methodist University

Description and definitions for each degree field were obtained from each institution's website. The section of the website that would provide insight as to what the degree field was and what type of job functions would be applicable were mined for common terminology used to describe such information to readers. Course curriculum was not included as part of the degree field description analysis, but was included for comparing each degree field's core curriculum.

To compare degree field definitions, terminology appearing in the definitions of the program of the B.S.E.M. institutions was compared to the terminology appearing in the definitions of the program of the M.S.E.M. institutions and the B.S.I.E. institutions. There were five institutions offering a B.S.E.M., five institutions offering an M.S.E.M, and nine institutions offering a B.S.I.E. For comparison purposes, terminology was defined as representative of the degree field for the Engineering Management institutions if it appeared in four or five of the targeted programs' definitions and representative of the Industrial Engineering degree field if it appeared in 7, 8, or 9 of the definitions provided by the targeted programs. Comparisons were also made between the B.S.E.M. programs and the M.S.E.M. programs to evaluate the similarities and differences between definitions and marketing in the same degree field, but within different degree programs.

In order to compare degree field curriculum to note similarities and differences, each institution (totaling 19) was evaluated and commonalities between degree programs were established to define a "common core" curriculum requirement. After these common core curriculums were established, they were compared between degree programs to assess similarities and differences.

Results & Discussion

After mining the definitions and descriptions of the B.S.E.M. institutions, the most common descriptive terms for this degree program were: engineering, management, systems, project management, people, business, problem solving, organizations, cost/finance, communication and manufacturing/production. The most common terms in the M.S.E.M. degree program were: technology, management, engineers, and organizations. Majority terminology for the B.S.I.E. degree program included: design, engineering, systems, manufacturing/production, information, people/human factors, and improvement. The distribution of terminology as they appeared in institutional program definitions can be seen in Tables 1, 2 and 3. For example, the term "engineering" appeared in five out of five B.S.E.M. definitions while the term "technology" appeared in only three out of five B.S.E.M. definitions.

Table 1: Bachelor of Science in Engineering Management

	5 Definitions	4 Definitions	3 Definitions	2 Definitions	1 Definition
Term	Engineering	People	Technology	Bridge the Gap	Material/Equipment
	Management	Business	Operations Management	Science	Decision Making
	Systems	Problem Solving	Ethics	Staffing	Controlling Resources
	Project Management	Organizations		Planning	Marketing
		Cost/Finance		Organizing	
		Communication		Leadership	
		Manufacturing/Production			

Table 2: Master of Science in Engineering Management

	5 Definitions	4 Definitions	3 Definitions	2 Definitions	1 Definition
Term	Technology	Organizations	Leaders	Science	Communication
	Management			Industry	Goals
	Engineers			Decisions	Operations Research
				Systems	Entrepreneurship
				Project	
				Ethics	
				Business	
				Finance	
				Production	

Table 3: Bachelor of Science in Industrial Engineering

	9 Definitions	8 Definitions	7 Definitions	6 Definitions	5 Definitions	4 Definitions	3 Definitions	2 Definitions	1 Definition
Term	Design	Engineering	Information	Machines/Equipment	Ethics	Analysis	Management	Social	Applications
		Systems	People/Human Factors	Materials	Math	Project Management	Business	Cost	Formulate
		Manufacturing/Production	Improvement		Sciences	Safety	Ergonomics	Computer/IT	Model
						Global	Quality	Problem Solving	Reliability
						Communicate	Corporate/Industry	Academics	Leadership
						Technology		Research	Controlling
						Service		Teamwork	Integration
						Operations			Economics
						Professional			
						Processes			

When comparing the terminology for the B.S.E.M. degree program to the B.S.I.E. degree program, 36% of the terminology appearing in 4 and 5 definitions of the Engineering Management programs also appeared in 7, 8 or 9 of the definitions of the Industrial Engineering programs. Ninety one percent (91%) of the terminology used in 4 or 5 of the definitions of the Engineering Management programs appeared in all of the Industrial Engineering programs' definitions. Fifty seven percent (57%) of the terminology used in 7, 8 or 9 definitions to describe the B.S.I.E. program also appeared as terminology used in 4 or 5 of the B.S.E.M. descriptions. The same 57% of terminology used in 7, 8, or 9 of the B.S.I.E. descriptions also appeared in all of the definitions used to describe the B.S.E.M. programs.

Comparing the terminology used in 4 or 5 of the descriptions used to describe the B.S.E.M. programs to the terminology used to describe the M.S.E.M. programs, 27% of the terms appearing in 4 or 5 of the B.S.E.M. definitions appeared in 4 or 5 of the definitions used to

describe the M.S.E.M. programs. Also, eighty two percent (82%) of the terminology used at the B.S. level showed up overall in the M.S. descriptions. Seventy five percent (75%) of the terminology used in 4 or 5 of the M.S.E.M. definitions also appeared as terminology used in 4 or 5 of the definitions used to describe the B.S.E.M. degree. Finally, 100% of the terminology used in 4 or 5 of the M.S.E.M. definitions also appeared in all B.S.E.M. definitions.

Table 4: Representative Terminology Comparisons

		Compared To:		
Base Program:	---------->	B.S.E.M.	M.S.E.M.	B.S.I.E.
	B.S.E.M.	----------	27%	36%
	M.S.E.M.	75%	----------	----------
	B.S.I.E.	57%	----------	----------

Table 5: Representative Terminology Comparison to Overall Terminology

		Compared To:		
Base Program:	---------->	B.S.E.M.	M.S.E.M.	B.S.I.E.
	B.S.E.M.	----------	82%	91%
	M.S.E.M.	100%	----------	----------
	B.S.I.E.	57%	----------	----------

After analyzing the preceding results concerning similarities and differences in terminology used to describe the Engineering Management and Industrial Engineering degree programs, the following observations were made:

1) The B.S.I.E. terminology that appeared in 7, 8 or 9 definitions overlaps the B.S.E.M. terminology appearing in 4 or 5 definitions (57%) more so than visa versa (36%).

2) The B.S.E.M. terminology appearing in 4 or 5 definitions overlaps the B.S.I.E. terminology appearing in all B.S.I.E. definitions (91%) more so than visa versa (57%).

After comparing the B.S.E.M. and M.S.E.M. programs, the following observations were made:

1) The M.S.E.M. terminology appearing in 4 or 5 definitions overlaps the B.S.E.M. terminology appearing in 4 or 5 definitions (75%) more so than visa versa (27%).

2) The M.S.E.M. terminology appearing in 4 or 5 definitions overlaps the B.S.E.M. overall terminology (100%) more so than the B.S.E.M. terminology appearing in 4 or 5 definitions overlaps the M.S.E.M. overall terminology (82%).

Curriculums of all 19 institutions were compared and summarized in tables in Appendix A. Again, curriculums were compared within like degree programs and a commonality was established for "core curriculum" offered by the majority of institutions offering that degree program.

After analyzing the curriculum of the institutions offering a B.S. in Engineering Management, the following was concluded: ABET accredited Engineering Management Programs offered at least one Accounting course, one Economics course, and one Statistics and Probability course as part of their General Engineering program or within their Engineering Management core classes. Three schools required Microeconomics and/or Macroeconomics as part of their General Engineering Programs, whereas other schools choose to teach just an Engineering Economics course. As for Accounting, three schools offered one course in General accounting, whereas one other school broke accounting requirements into two courses focusing on Managerial Accounting and then Financial Accounting.

All of the accredited Bachelors Programs offered at least one course in General Management & Leadership as well as Operations & Production Management, thereby establishing the "core curriculum" for the institutions offering the B.S.E.M. degree. All accredited programs also offered some sort of Senior Capstone course, but all schools offered a different combination of seminar, design, and internship. Table 6 shows the capstone requirement comparisons.

Table 6: B.S.E.M. Capstone Requirement

		EMGT Capstone Requirement		
		Seminar	Design	Internship
EMGT Institution	UMR	x		
	Stevens		x	
	Arizona	x		x
	Pacific			x
	West Point		x	

All of the programs offering the B.S.E.M. degree, with the exception of Stevens, offered a course in Marketing. A course in Project Management was offered by three of programs core courses, Stevens, Pacific, and West Point, where it is only an elective course within UMR's program. Stevens and Arizona offered Total Quality Management (TQM) as part of their core courses, where as other schools, such as UMR offered TQM only as an elective course. Simulation was offered as part of Stevens and Pacific's program, which is a core course offered within most Industrial Engineering programs. Also, only Pacific and West Point offered a course in Systems Management.

When analyzing and trying to establish common emphasis areas, it was determined that none of the five schools were alike in their optional offerings. Stevens did not offer any emphasis areas,

as there degree program required straight core courses. UMR seemed to have the most complete offering of emphasis areas, with 4 specialized areas within Engineering Management fields, as well as a General emphasis area, focused in any other Engineering field. West Point, Arizona, and Pacific also offered emphasis areas in other Engineering fields. West Point and Pacific offers a General Engineering Management emphasis as well. However, Arizona offers not only emphasis in any other Engineering degree but also offers emphasis areas in specific industries such as Bioengineering, Optics, and Food Processing.

It was interesting to find that UMR is the only school of the B.S.E.M. institutions to offer a specific Industrial Engineering emphasis. However, Stevens does offer two courses that are also offered in most IE programs, which are Operations Research and Materials Processing.

Based on study of curriculums from five ABET accredited B.S.E.M. programs and nine ABET accredited B.S.I.E. programs, the typical "core curriculum" offerings for both a B.S.E.M. and B.S.I.E. program are summarized in Tables 7, 8, and 9.

Table 7: B.S.E.M. Program Curriculum Comparison

		Engineering Management Institution				
		UMR	Stevens	Arizona	Pacific	West Point
Course Type	Management/Leadership	x	x	x	x	x
	Marketing	x		x	x	x
	Accounting	x	x	x	x	x
	Economics (Micro/Macro)	x	x		x	
	Engineering Economics	x	x	x		x
	Ops & Production Mgt	x	x	x	x	x
	Senior Seminar	x		x		
	Senior Design		x			x
	Internship			x	x	
	Stats/Probability	x	x	x	x	x
	TQM		x	x		
	Project Management		x		x	x
	Simulation		x			x
	Systems				x	x
	Emphasis Areas	x				
	General Eng Mgt				x	x
	Other Engineering fields	x		x	x	x
	Industry			x		

Table 8: B.S.I.E. Program Curriculum Comparison

Course Type	Milwaukee	Wisconsin	Georgia Tech	Purdue	Cal Poly - San Luis Obispo	Michigan - Ann Arbor	Cal Poly - Pomona	Kettering	Bradley
Micro/Macro Economics	x					x	x	x	
Engineering Economics	x	x	x	x	x				x
Accting	x		x						
Prob/Stats	x		x	x	x	x	x	x	x
Ethics	x						x		
Intro/Fund	x	x			x		x	x	x
SPC	x				x		x		x
TQM		x	x		x	x		x	x
Ops Research	x	x	x	x	x	x	x		x
Ergonomics	x				x	x			x
Human Factors		x	x	x	x	x	x		x
Work Design		x			x	x	x	x	
Facilities Design	x	x		x		x	x		x
Materials	x	x						x	x
Prod Planning, Inventory Control		x	x	x	x		x		x
Automation	x				x				
Simulation	x	x	x		x	x	x		
Systems	x	x	x		x		x	x	x
Manu. Process	x			x	x		x		
Senior Design	x		x	x	x	x	x	x	x
Emphasis Areas		x						x	

Table 9: Curriculum Summary

B.S. in Engineering Management	B.S. in Industrial Engineering
General Management & Leadership	Economics (Micro &/or Macro; Eng Econ)
Accounting	Probability & Statistics
Economics (Micro &/or Macro; Eng Econ)	Operations Research
Probability & Statistics	Ergonomics, Human Factors, Work Design
Operations & Production Management	Production Planning, Inventory Control, Scheduling
Marketing	Systems Analysis
Total Quality Management	Senior Design or Project
Project Management	Automation, Simulation, or Manufacturing Processes
Senior Seminar & Internship or Senior Design	Statistical Process Control & Quality Methods
18 hours in emphasis area	Facilities Design, Materials Handling, & Plant Layout

Only two of the B.S.I.E. schools offered emphasis areas, University of Wisconsin – Platteville and Kettering University. Wisconsin offered emphasis areas in Production or Engineering Management. Kettering University offered emphasis areas in Quality Assurance, Work Design, Manufacturing, or Cognate (no concentration). However, the University of Michigan – Ann Arbor required 18 hours of Technical Electives with the choice of one course from 4 groups of courses (Facilities Design & Layout, Quality & SPC, Human Factors & Safety, and Business Strategies & Finance) with the remaining two courses from any of the groups.

It was also noted that some of the B.S. I.E. curriculum programs were more focused on Computer Integrated Systems and Applications of Computers within the Industrial Engineering field, such as at Bradley University, than most B.S.I.E. programs used in this study.

When comparing the B.S.E.M. established core curriculum to the B.S.I.E. established core curriculum, it is apparent that the only overlapping courses are Economics, Probabilities & Statistics, and Statistical Process Control & Total Quality Management. Also, seemingly the

B.S.E.M. core curriculum is more focused towards management and business matters such as General Management & Leadership, Accounting, Marketing, Operations & Production Management, and Project Management. However, the B.S.I.E. core curriculum is more focused on Manufacturing and Work Analysis such as Operations Research; Ergonomics, Human Factors, & Work Design; Facilities Design, Materials Handling, & Plant Layout; Production Planning, Inventory Control, & Scheduling; and Systems Analysis.

However, if comparing the B.S.I.E. core curriculum to the core curriculum of UMR's B.S.E.M. degree program with an emphasis in Industrial Engineering as listed in Table 9 and Appendix A, there is not much notable difference between the two curriculums thereby making them possible competitors in the industry of engineering. Both programs offer courses listed in Table 10.

Table 10: Course Offering Comparison

Similar Course Offerings Between B.S.E.M. with Emphasis in I.E. and B.S.I.E.
Economics (Micro &/or Macro; Eng Econ)
Probability & Statistics
Operations Research
Ergonomics, Human Factors, Work Design
Facilities Design, Materials Handling, & Plant Layout
Production Planning, Inventory Control, & Scheduling
Statistical Process Control

Some of these similarities could possibly be used to integrate the two degree programs into a more consistent offering and an overall more valuable degree. The B.S.I.E. core curriculum also includes Quality Methods (such as SPC & TQM), Systems Analysis, and Automation & Simulation, as well as a year long Senior Design Project. The UMR Engineering Management degree with IE emphasis instead includes General Management & Leadership, Accounting, Operations & Production Management (which covers an overview of all techniques used in industry), and Marketing. Seemingly an argument could be made that the two degrees overlap enough to be competitive against one another and/or similar marketing techniques used to promote each program.

Summary

The goals of this study were to realize similarities and differences between the degrees of B.S.E.M, M.S.E.M, and B.S.I.E. and to establish if a common marketing schema could be identified in order to clearly and consistently market the degree field of Engineering Management. Definition and description comparisons between the B.S.E.M. degree and the M.S.E.M. degree, as well as between the B.S.I.E. and the B.S.E.M. degrees, were made. Also, curriculum comparisons were made between the B.S.E.M. programs, between the B.S.I.E. programs and also between the B.S.E.M. and B.S.I.E. programs.

These comparisons were made in order to identify a "core curriculum" common to all five ABET accredited B.S.E.M. programs and for the nine ABET accredited B.S.I.E. programs. After these

comparisons were made and the core curriculums established, it was concluded that the B.S.E.M. program overlapped the B.S.I.E. program more so than the B.S.I.E. program overlapped the B.S.E.M. in terms of the terminology used to describe each program as defined by the "top majority" criteria presented earlier. Speculation can be made that perhaps this is true due to the fact that there were 11 common "top terminology" terms used to describe the B.S.E.M. programs while there was only 7 common "top terminology" terms used to describe the B.S.I.E. programs. From this analysis, it has been concluded that the five accredited B.S.E.M. programs are not as alike as one might suspect for being the same degree program. UMR's B.S.E.M. program was the only program to offer individual specific emphasis areas (Industrial Engineering, Management of Technology, Quality, and Manufacturing) while the other B.S.E.M. programs offered either just a General Engineering Management emphasis area or required that their students seek out an emphasis outside of the degree program.

Conclusion

It can be concluded that in general, when comparing the most commonly used terminology in the program descriptions, a Bachelor of Science in Industrial Engineering is closely related to a Bachelor of Science in Engineering Management. However, a Bachelor of Science in Engineering Management is significantly different that one on Industrial Engineering. Also, when the curriculum offered in a Bachelor of Science in Engineering Management with an emphasis in Industrial Engineering (such as UMR's unique B.S.E.M. program) was compared to a Bachelor of Science in Industrial Engineering, it was found that the curriculums were very similar and that it would be reasonable to consider each of them a competitor in the engineering field for the other and that they could be marketed similarly. Traditional Bachelor of Science in Engineering Management programs that do not offer specific emphasis areas are not as similar to a Bachelor of Science in Industrial Engineering and would not be a strong competitor for the Bachelor of Science in Industrial Engineering programs.

The M.S.E.M. program is similar to the B.S.E.M. program while the BSEM degree is significantly different that the MSEM. This stands to reason that a M.S. degree in a field would be closely related to its B.S. predecessor, yet further demonstrates the uniqueness of the B.S.E.M. degree from the M.S.E.M. degree in this field and that perhaps separate marketing schema are appropriate.

Bibliography

1. Personal communication.
2. ABET (2006), from www.abet.org.
3. U.S. News & World Report (2007), from http://www.usnews.com/usnews/edu/college/rankings/brief/t1natudoc_brief.php.
4. Daughton, W. J. (2005). Evaluation of Engineering Management Programs. Internal Report. .

Appendix A

B.S.E.M. Curriculum

	UMR	Stevens	Arizona	Pacific	West Point
CORE	Management (211)	Engineering Mgt	Accounting	Eng. Administration	Org Mgt & Leadership (2)
	Marketing (251)	Project Mgt	Probability and Stats	Systems Eng. Mgt	People Mgt Engineering (1)
	Accounting (230)	Eng. Cost Estimation	Sociology of Workplace	Eng. Project Mgt	Eng Econ (1)
	Financial Management (252)	Statistics for EM	Org Communications	18 hours from option	Info & Decision Systems (1)
	Operations & Production Mgt (282)	Eng. Mgt Lab	Tech Sales and Marketing	1 year of co-op	Simulation (1)
	Gen. Mgt & Design (260)	Eng Design (6,7,8)	Ops Mgt		
		Modeling and Simulation	Legal Aspects of Engineering		Required
		TQM	TQM		Analytical Method for EM
		Mgt of Info Networks	Planning, Leadership, & Personnel		Eng. Econ
		Elements of Ops Research	Eng. Econ		EM Design I & II
		Logistics and Ops Mgt	Senior Seminar		Production Ops Mgt
			Capstone Internship		Project Mgt
					Intro to Eng Design & Systems Mgt
					Professional Eng. Seminar
					Systems Acquistion Mgt
Outside Dept	Microeconomics or Macroeconomics	Engineering Econ	18 hours outside dept (emphasis)	Principles of Fin. Accounting	Probablity/Statistics
	Statistics for Engineers	Materials Processing		Mgt & Org Behavior	Accounting
		Microecon		Principles of Mgr. Accounting	
		Macroecon		Marketing Mgt	
				Financial Mgt	
				Operations Mgt	
				Statistics/Probability	
				Microeconomics	
				Macroecomonics	
Emphasis	IE (6)		Bioengineering/PreMed	6 courses from options:	Choose Track (9 hours)
	Matl Handling & Plant Layout (257)		Information Technology		Civil
	Human Factors (311)		Environmental Affairs	Civil	Mechanical
	Production Planning & Scheduling (372)		Process Industry		Electrical
	Work Design (380)		Construction Industry	Mechancal	Environmental
	Intro to Ops Research (382)		Gen Manufacturing		Nuclear
	SPC (385)		Food Processing	Electrical	
	(2 other Electives)		Optics		General:
			Minor in another Engineering field	General:	Required
	MOT (6 of 7)			Systems Analysis	Info & Decision Systems (1)
	Eng Econ (208)			Mechanics of Materials	Simulation (1)
	Mgr Decision Making (313)			Systems Eng. Mgt	Random Elective
	Tech Enterpreneurship (320)			EM Synthesis	and one of the following emphasis:
	Legal Environment (327)			Gen Electives:	Business Ops & Mgt (2)
	MIS (333)			Material Science	Org Leadership & Theory (2)
	Project Mgt (361)			2 from Civil	
	Bus Logistics Systems Analysis (366)			3 from Mechanical	
	(2 other Electives)			2 from Electrial	
	Manufacturing (6)				
	Cmp Integrated Mfg Sys (334)				
	Interdisp Prob in Mfg Auto (344)				
	Integ Prod & Process Design (354)				
	Value Analysis (364)				
	Production Planning & Scheduling (372)				
	Packaging Mgt (383)				
	(2 other Electives)				
	Quality (6 of 7)				
	Project Mgt (361)				
	Eng. Design Optimazation (374)				
	TQM (375)				
	Intro to Quality Eng (376)				
	Mgt & Methods in Reliability (381)				
	SPC (385)				
	Exp in Eng Mgt (387)				
	(2 other Electives)				
	General				
	18 hours in another Engineering field				

B.S.I.E. Curriculum

	Milwaukee University (trimesters)	University of Wisconsin-Platteville	Georgia Institute of Technology	Purdue University	Cal Poly - San Luis Obispo	University of Michigan - Ann Arbor	Cal Poly - Pomona	Kettering University	Bradley University
CORE	Intro to IE	Fundamentals of IE	Probability	Probability & Statistics I & II	Intro to Ind & Manu Engineering	Economic Decision Making	Fund of Human Factors Engineering	Interdisciplinary Design & Manu	Intro to Ind & Manu Eng
	Computer Applications in IE	Human Factors Engineering	Models in IE	Computing in IE	Manufacturing Processes: Net Shape	Operations Modeling	Elements of IE Systems	Algorithms & Comp Programming	Computer Aided Graphics
	Application of Stats in IE	Operations Research	Statistics	Operations Research (Optimization)	Intro to Design & Manufacturing	Probability & Statistics	Operations Research I & II	Systems Analysis I	Intro to Computers & Computation
	Quality (SPC)	Work Measurement & Design	Engineering Economy	Operations Research (Stoic. Models)	Work Design & Measurement	Intro to Opt Methods	Systems Simulation	Engineering Stat II	Computer Numerical Applications
	Deterministic Modeling & Optimatization	Production & Operations Analysis	Quality Methods	Engineering Economy	Industrial Costs & Controls	Intro to Markov Processes	Operations Planning & Control	Systems Modeling I	Engineering Economy I
	Ergonomics & Methods Development	Facilities Design	Logistic	Manufacturing Process I	Manufacturing Engineering Analysis	Ergonomics	Ind & Manu. Fundamentals	Engineering Materials	Intro to Eng Statistical Methods
	IE Junior Project	TQM	Stoicastic Manufacturing & Service Sys	Integrated Production Systems I	Operations Research I	Ergonomics Lab	Ind & Manu. Computational Lab	Work Design I	Ind & Mgrial Engineering
	Stoicastic Processes	Engineering Management	Simulation	Work Analysis & Design I	Data Mgt & System Design	Linear Statistical Models	Work Analysis & Design	Sys Analysis II (Prod Sys Design)	Fundamentals of Materials Science
	Engineering Economy	Industrial Systems Design	Manufacturing & Warehousing	IE Design	Engineering Economics	Data Processing	Industrial Costs & Controls	Engineering Stat III	Engineering Economy II
	Materials & Manufacturing Processes	Engineering Materials	Human Integrated Systems	Industrial Controls Systems	Human Factors Engineering	Simulation	Applications of Statistics	Work Design II	Engineering Statistical Methods
	Contemp. Int. Manufacturing Systems		Senior Design I & II	Work Analysis & Design II	Engineering Test Design & Analysis	Senior Design	Production Planning & Control	Systems Analysis III	Operations Research I
	Simulation		Eng Optimatization	Tech Electives (15 credits)	Comp Aided Manufacturing I or	Technical Electives (18 hours)	Facilities Planning, Layout, & Design	Quality Systems I	Transport Phenomena
	Facilities Design			Must include 1 of the following:	Manufacturing Automation		QC by Statistical Method	Applied Control Systems Design	Operations Research II
	Computer Int. Manufacturing			Manufacturing Process II	Operations Research II & III		Senior Project	Senior Design Project	Facilities Planning
	Engineering Project Management			Integrated Production Systems II	Inventory Control Systems		Manufacturing Systems Processes	3 IE electives from emphasis	Manufacturing QC
	IE Senior Design I & II				Simulation & Expert Systems				Information Systems Design
	Automation I				Manufacturing Organizations				Simulation of Human/Machine Sys
	Team Leadership/Facilitation				Ergonomics Lab				Occupactional Ergonomics
	12 credits of IE Electives				Quality Engineering				Senior Ind Design Project
					Engineering Supervision I				Production Planning & Control
					Facilities Planning & Design				
					Senior Project Design Lab I & II				
					14 IE Tech Electives				
Outside Dept	Microeconomics	Engineering Economy	choice of 1:		Statistics for Engineers		Ethics	Economic Principles	
	Accounting		Orgizational Behavior				Principles of Economics		
	International Business		Principles of Management						
	Mgt Systems Electives		Accounting I						
	Ethics for Pro Mgrs & Engineers								
			choice of 1:						
			Econ & Financial Modeling						
			Finance & Investments						
Emphasis		Production: (12 credits total)				one from each of the following:		Quality Assurance:	
		Manufacturing Processes				Production & Inventory Control		Qual Sys II (Reliability & Maintainability)	
		Manufacturing Systems Designs				Facility Planning		Qual Sys III (Adv Quality Assurrance)	
		choice of 2:				Materials Handling Systems		one of the following:	
		Simulation						Design for Manu & Assembly	
		Materials Handling/Warehousing				Queueing Systems		Failure Analysis	
		Principles & Design of Eng (MIS)				Decision Analysis			
		Cost & Value Analysis				Quality Engineering Principles		Work Design:	
		Advanced Materials				Experimental Design		Sys Model II (Prod Sys & Simulation)	
						Statistical Quality Control		Work Design III (Safety & HF)	
		Engineering Management (12 credits)						one of the following:	
		Project Management				IE Instrumentation Methods		Design for Manu & Assembly	
		Cost and Value Analysis				Human Factors in Computer Systems		Ethics & Practice of Engineering	
		choice of 2:				Safety Management			
		Simulation				Advanced Topics in Safety Mgt		Manufacturing:	
		Materials Handling/Warehousing				Work Measurement & Prediction		CNC Machining	
		Principles & Design of Eng (MIS)						1 Process Elective	
		Human Resources Management				Work Organization & Analysis		1 Integration Elective	
		Small Business Management				Entrepreneurship			
						Manufacturing Strategies		Cognate (No Concentration):	
						Corporate Finance		3 IE Electives	
						Derivation Instruments			
						any other 2 courses listed			