WHAT ARE WE TEACHING OUR ENGINEERING MANAGERS?

by

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ABSTRACT
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Title What Are We Teaching Our Engineering Managers?

Engineering management and management of technology programs throughout the United States of America are entrusted with educating future leaders of industry and technology. Little, if any, research has been conducted on the nature of the methods and tactics being taught. With much of the industrial base of the U.S. moving overseas, America's lead in technology becomes a potent economic and industrial force for the future. Harnessing this potent force can lead to prosperity and success for the entire nation. However, the failure to characterize the existing programs in the U.S. can lead to a failure by both industry and academia to evaluate the direction and context of future U.S. leadership in the global marketplace.

The research conducted in this study used the schools of management thought as developed by Dr. Harold Koontz in his article "The Management Theory Jungle" to classify various engineering management and management of technology programs (Koontz, 1961). A modification by combining similar schools of management thought allows the six schools to be reduced to three. The three schools used in this study were Management Process/Empirical, Human Behavior/Social Systems, and Mathematical/Decision Theory. The results of the study pointed to the heavy use of the Mathematical/Decision Theory school of thought by most of the engineering management and management of technology programs.

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Chapter I

THE PROBLEM

A. Introduction

Engineering management and management of technology programs throughout the United States are educating our future technical leaders in the art and science of management. With much of the U.S. industrial base being moved overseas due to increased competition in the expanding global economy, the U.S. has become heavily dependent on the development and proliferation of new technology (Reich, 1990). The advent of the Information Revolution, in the form of the Internet, e-mail, computers, cellular phones, pagers, etc., has increased the emphasis on the importance of new technologies and identifies a relatively untapped marketplace for consumption of goods. The United States has pulled the rest of the world into this revolution through unparalleled advancements and breakthroughs in electronics and information technologies (Gross, 1994). Many countries stand poised to take the reigns of leadership in the Information Revolution by educating numerous working-age individuals in the technology that Americans have built (Gross, 1994).

Through this all, the U.S. cultural identity has remained relatively unchanged during the same period. The ideas of self-reliance, independence, and invention still rule the psyche of the American populace (Tregoe, 1983). The principles of management have remained relatively unchanged during this period as well. The teachings of scientific management with heavy emphasis on mathematical tools rule the industries in the United States (Berger, 1989). Success stories external to the U.S. have shown substantial cost reductions and quality improvements through the use of teamwork and process improvement. The U.S. stands on the precipice of developing a major economic success during the Information Revolution. The question is how

are we preparing the future leaders and supervisors in technology to support and nurture American industry during this period.

B. Purpose of the Study

The purpose of this study is to provide an objective analysis of selected engineering management and management of technology programs throughout the United States and classify them according to a modified version of the six schools of management thought as discussed by Koontz (Koontz, 1961). The effort will create a snapshot in time of the current state of engineering management and management of technology in the U.S. It is not the purpose of this paper to decide the appropriateness of the programs in question, but to provide the reader with the basic layout of the programs in question.

C. Statement of the Problem

Engineering management and management of technology programs throughout the United States vary in composition due to many factors. These factors include local industry needs, areas of research interest, faculty emphasis, geographic location, and academic guidance from universities and accreditation boards. The factors are important in shaping the curriculum taught to the many students graduating from the programs, and usher forth new ideologies in the work environment with each graduate. Each graduate then takes the tools and concepts into the workplace and utilizes them to the benefit (or detriment) of the company.

The programs in engineering management and technology management have a significant influence on the workers and economics of U.S. industry. However, characterization of the programs to understand the overall impact has not been accomplished. Providing a frame of reference for all engineering management and management of technology will give a clear understanding of the general direction of the U.S. programs and, therefore, how industry will be

affected. Instruction of engineering management and technology management will indicate how future graduates will impact the U.S. economy and industry.

D. Hypothesis

As stated previously, the American culture and styles of management have not changed with the transformation of industry. The previous focus of management on short-term gains, control, division of labor, reduction of labor costs, and optimization through mass production are still evident in the rising technology industries in the U.S. The hypothesis for this study is that a majority of the engineering management and management of technology programs will be significantly weighted towards the Mathematical/Decision Theory schools of thought.

E. Significance of the Study

This study has significant bearing on the future of U.S. leadership in technological innovation and the direction of American industry. By identifying the focus and primary efforts of the programs, the study will develop a window to identify the skills being taught to graduates entering the industrial work force. The results of the study will point the direction that future leadership of the U.S. industrial base will take while rising through the ranks of organizations. Eventually, these leaders will influence the climate, politics, and economics of U.S. industry.

Chapter II

REVIEW OF LITERATURE

A. Introduction

Research of publications relating to the engineering management discipline did not yield any results to verify the existence of similar studies. Much of the reason behind the lack of research in this area or using the techniques employed is related to the responses from engineering management professional educators at the responding programs. The overall consensus was that forces outside the control of the programs and instructors have driven the variance on the styles of instruction involved. This fact alone has given many of the instructors the feeling that this type of study will not bear significant influence or bearing on the subject matter. To the contrary, the fact that no one has undertaken this approach underscores the importance of this study in providing a characterization of the programs and the direction of the future of engineering management in the United States.

Koontz's article "The Management Theory Jungle" represented a first in the classification of the many distinct divisions in management (Koontz, 1961). His objective accounting of the different approaches to management provides fertile ground for characterizing different areas of management. In the article, he provides the framework for defining the different schools of thought through sound evidence supporting each philosophy. A noted feature of the article is the objective accounting and consideration of the different schools of thought. Instead of judging the schools, Dr. Koontz presents the advantages, disadvantages, and challenges for all of the differing approaches. Dr. Koontz further provides recommendations emphasizing the importance of "disentangling the management theory jungle" to society as a whole (Koontz, 1961). Management in any form has a far-reaching impact on the economy and

people of the United States. Therefore, understanding the basic components that make up the direction of engineering management and management of technology has a significant bearing on the direction of U.S. industry and technology.

B. Management Process School

Henri Fayol is credited with developing the Management Process School of Thought (Koontz, 1961). Fayol's work focused primarily on the functions of the manager (Fayol, 1949). However, the bulk of Fayol's work was overshadowed by the principles of scientific management as developed by Frederick W. Taylor (Koontz, 1961) (Taylor, 1911). The Management Process approach focuses on management as a process of getting things done through and with people. The attempt is to "analyze the process, establish a conceptual framework for it, identify the principles underlying it, and build a theory of management from it" (Koontz, 1961). The thrust of the school is that management is a universal process regardless of the enterprise or the level in the enterprise.

The fundamental beliefs of the school are:

1) Management is a process and is best analyzed by studying the functions of the manager.
2) Long experience with management in differing enterprises can produce certain fundamental truths which have a predictive nature and can assist in understanding and practicing management.
3) The fundamental truths can become the focus of research to validate findings and improve their meaning and applicability.
4) The fundamental truths can provide input for a useful theory of management.
5) Management is an art, like engineering, that can be improved by understanding certain principles.

6) The principles of management are true even if the manager ignores them.

7) The physical and biological sciences have influence on the manager's environment, but the theory of management does not need to address all issues to serve as a scientific or theoretical foundation.

Koontz states, "The basic approach of this school is to look, first, to the functions of managers" (Koontz, 1961). The next step of this approach is to take these functions and scrutinize them further into fundamental truths (Koontz, 1961).

C. Empirical School

Included in this school are individuals who identify management as a study of experience (Koontz 1961). Sometimes they intend to make generalizations but usually use the method as a means of teaching experience to the student. Typical proponents of this school see management as the study and analysis of cases. Ernest Dale uses this methodology in his "comparative approach" (Dale, 1960). This approach attempts to study the successes and failures in management and involve students in solving management problems. The expected result is that managers will learn to apply the most effective kinds of management techniques. Individuals following this approach remark that analyzing cases form certain generalizations that can be applied and practiced in future case situations. The student or manager evolves principles through experience, either from cases or from individual experiences. According to Koontz, "This approach tends to be and do the same as the management process school" (Koontz, 1961).

D. Human Behavior School

The central thesis of this school is that "since managing involves getting things done with and through people, the study of management must be centered on interpersonal relations" (Koontz, 1961). Tannenbaum, Weschler, and Massarik identify this approach as bringing forth

the "existing and newly developed theories, methods, and techniques of the relevant social sciences upon the study of inter- and intrapersonal phenomena, ranging fully from the personality dynamics of the individuals at one extreme to the relations of cultures at the other" (Tannenbaum, 1961). The Human Behavior School concentrates on the "people" part of management.

Individuals using this approach rely heavily on psychology and social psychology. Dr. Koontz states, "Their primary focus is on the individual as a socio-psychological being and motivational factors for the individual" (Koontz, 1961). Members of this approach vary in beliefs ranging from seeing the techniques as a portion of the manager's job to seeing the psychological behavior of individuals and groups as the total of management. Some members equate management to leadership and treat group activities as "managed" situations. Others, however, study group dynamics and interpersonal relationships as a study of socio-psychology and are simply attaching "management" to the field of socio-psychology (Koontz, 1961). Examples of this approach include Maslow's Hierarchy of Needs (Maslow, 1943), McGregor's Theory X and Theory Y (McGregor, 1960), Herzberg's Two Factor Theory of Motivation (Herzberg, 1968), and McClelland's Theory of Need for Achievement (McClelland, 1961).

E. Social Systems School

The Social Systems School is closely related to the Human Behavior School and is sometimes confused with it (Koontz, 1961). The emphasis of this approach is to look upon management as a social system or system of cultural interrelationships. Members of this school vary in topics from limiting the study to formal organizations to encompassing any kind of system of human relationships. The school is heavily influenced by sociology and attempts to identify the nature of the cultural relationships of various social groups and attempts to show these as a related and integrated system (Koontz, 1961).

The father of this school of management is recognized as Chester Barnard (Barnard, 1938). His development of a theory of cooperation founded in the needs of the individual to cooperatively solve the biological, physical, and social limitations of the individual and environment engendered one set of interrelationships defined as the "formal organization" (Koontz, 1961). Many of the contributors to this approach show definitive signs of using the cooperative systems theory in their work (Koontz, 1961). Examples of this approach include the Hawthorne Experiments (Mayo, 1945), Blake and Mouton's Managerial Grid (Blake, 1964), and Likert's System Four (Likert, 1961).

F. Decision Theory School

The Decision Theory School approach focuses on the rational approach to decision making – "the selection of a course of action or of an idea from various possible alternatives" (Koontz, 1961) (Luce, 1957). The approach may pay attention to the decision itself, the individual or work groups making the decision, or the analysis of the decision process. Individuals associated with this school range from limiting themselves to the economic rationale of the decision process, to considering any action in a company for analysis, to including psychological and sociological implications of decisions and decision makers.

This school has grown from the theory of consumer's choice. The Decision Theory approach has risen from economic problems and analyses to include "utility maximization, indifference curves, marginal utility, and economic behavior under risk and uncertainty" as well as statistical tools to further analyze the economic principles (Koontz, 1961). Most of the members of this school are economic theorists and focus on model construction and mathematics. The Decision Theory School has extended its influence to include "organization structure, psychological and social reactions of individuals and groups, development of basic information for decisions, analysis of values and value considerations with respect to goals,

communications networks, and incentives" (Koontz, 1961). The effects of this extension of the school have been that the approach has broadened to examine the enterprise as a social system (Koontz, 1961). Typical of this approach are Game Theory, decision trees, decision making under uncertain conditions, and probabilistic engineering economics (Luce, 1957) (Miller, 1960).

G. Mathematical School

As stated implicitly in the name, this school sees management as a system of mathematical models and processes. Members of this school include operations researchers or operations analysts. The belief of the Mathematical School is that management, the organization, planning, and decision making are a logical process and can be expressed in terms of mathematical symbols and relationships (Miller, 1960) (McCloskey, 1954) (Churchman, 1957). The central approach used is that of the model to express basic relationships in terms of selected goals or objectives. Contributions of this school include providing the ability for management to see problems more clearly, established the need for setting goals and measures of effectiveness, validating the management areas as a logical system of relationships, and refined management information sources and systems for sensible quantitative meaning. Operations research, linear programming, and optimization algorithms are typical of this approach (Dantzig, 1963).

Chapter III

METHODOLOGY

A. Introduction

The methodology employed in collecting and analyzing data was designed to answer the following questions:

1) What core courses are being taught by engineering management and management of technology programs throughout the United States?
2) What is the specific emphasis of each core course?
3) After analyzing each course, what is the overall emphasis of the specific engineering management or management of technology program?
4) What is the characterization of the programs throughout the United States?

Collection of data from the programs began with the identification of engineering management and management of technology programs throughout the U.S. Through the assistance of Dr. Ted Eschenbach, Editor of the American Society of Engineering Managers Journal, contact was made with Dr. Dundar F. Kocaoglu. Dr. Kocaoglu, Director of Engineering Management at Portland State University, provided a comprehensive listing of engineering management and management of technology programs throughout the world. Limiting this data to U.S. institutions only and using data available through the Internet, the selection of thirty-three programs across the country was made. These programs were selected because they represented a cross section of the different curriculums in existence. The requests for data regarding this research were made using the letter given in Appendix A. The thirty-three programs initially selected for the study are listed as an attachment to the letter in Appendix A.

B. Collection of Data

Mercer University was removed from the original listing due to the unavailability of a complete mailing address for the engineering management program. Approximately three weeks after the initial letter was sent, a follow-up e-mail was sent to programs that had not responded. The e-mail condensed the request from the initial letter and again requested a response for data for the research.

Of the remaining thirty-two programs, responses were received from nineteen. The responses from programs ranged from full documentation as requested to receipt of only a graduate catalog. An additional attempt was made to obtain information from the respective program and engineering management web sites on the Internet. This provided enough information to include three additional programs to the analysis. A majority of the information available on the Internet tended to be incomplete and not up-to-date for use in the analysis.

National Technological University (NTU) was removed from the analysis due to the use of multiple engineering management and management of technology programs to fulfill requirements for the degree program. With more than one university teaching a required topic, the program at NTU could take on many variations based upon the student's selection and the institutions offering courses. The University of Maryland also was removed from the analysis due to the program emphasizing reliability engineering instead of engineering management or management of technology. This data would not fall into the same category as the other programs being studied and would represent a distant outlier from the normal composition of courses.

The final data set for this research topic included 20 programs. The programs were Arizona State University, Florida Institute of Technology, George Washington University, Kansas State University, Lamar University, New Jersey Institute of Technology, New Mexico State University, North Dakota State University, Northeastern University, Old Dominion

University, Pennsylvania State University, Portland State University, University of Alabama in Huntsville, University of California - Davis, University of Dayton, University of Denver, University of Louisville, University of Missouri at Rolla, University of South Florida, University of Tennessee at Knoxville, and Washington State University.

C. Criteria for Analysis of Core Courses

The specific criteria for analyzing the core courses from each of the engineering management and management of technology programs were taken directly from Koontz's article "The Management Theory Jungle" (Koontz, 1961). A modification was made to the original six schools of management thought in order to narrow the classifications of classes, programs, and overall ratings. The method employed was to group like schools together. As mentioned in Koontz's work, the Management Process and Empirical Schools were related, and the Human Behavior and Social Systems Schools were related. The Mathematical and Decision Theory Schools were not listed as related in Koontz's article. However, the use of modeling, statistics, and mathematical algorithms in decision making allowed for these schools to be readily combined into one school of management thought.

The research included the experience and study of the researcher in identifying the appropriate items for inclusion in the analysis. The following information identifies the characteristics for the three schools of management thought used in the research:

1. Management Process/Empirical School

Criteria:

a. Planning, Organizing, Staffing, Leading, Controlling.

b. Managing as a process; dissected into manager's functions.

c. Long experience leads to fundamental principles that clarify and predict understanding and improvement of managing.

d. Fundamental beliefs are focal points of research, study, and application.

e. Scientific, theoretical foundations for management practice.

f. Leave out areas of sociology, economics, biology, psychology, physics, and chemistry.

g. Management learned through experience.

h. Intent is to draw generalizations but most often routinization of principles by transferring experience to students and practitioners.

i. Extensive study of cases to simulate this experience.

j. Analyze successful management practices and mistakes of management practices in the hopes of learning the application of the most effective management techniques.

2. Human Behavior/Social Systems School

Criteria:

a. Trying to meet unfulfilled needs motivates workers to higher performance.

b. Understand the behavior of employees and open communications with them.

c. Since managing involves getting things done with and through people, the study of management must be centered on interpersonal relations (Koontz, 1961).

d. Use of the existing and newly developed theories, methods, and techniques of the relevant social sciences upon the study of inter- and intrapersonal phenomena, ranging from personality dynamics of individuals to relations of cultures (Koontz, 1961).

e. "People" part of management. Rests on principle that since people work together in groups to accomplish objectives, "people should understand people," and has as its primary focus the motivation of the individual as a socio-psychological being (Koontz, 1961).

f. Leadership, human relations, group dynamics, interpersonal relationships.

g. Work is done in groups, and the effective functioning of groups is the key to increased productivity.

h. Independence, team action, and group incentives are viewed as effective.

i. Management viewed as a social system of cultural interrelationships (Koontz, 1961).

j. Identifies nature of cultural relationships of various social groups and attempts to show them as a related and usually integrated system (Koontz, 1961).

3. Mathematical/Decision Theory School

Criteria:

a. Use of the management science approach. Management consists of making decision under risk and uncertainty and is affected by predictable factors (i.e. economics, finance).

b. Rational approaches to decision making. Selection of a course of action or of an idea from various possible alternatives.

c. May deal with decision itself, with persons or organizational group making decision, or analysis of the decision process.

d. Use of the operations research approach. Operations research is the professional discipline that deals with the application of scientific methods to decision making. It draws upon ideas from engineering, management,

mathematics and psychology to contribute to a wide variety of application domains; the field is closely associated with several other fields in the "decision sciences" -- applied mathematics, computer science, economics, statistics, industrial engineering, financial engineering and systems engineering.

e. Views management as a system of mathematical models and processes.

f. Management, organizations, planning, or decision making is a logical process. It can be expressed in terms of mathematical symbols and relationships.

g. Simplification of complex issues into mathematical symbols and relationships.

D. Validation of Methodology

In order to validate and evaluate the methodology being used, the University of Alabama in Huntsville was selected for initial analysis. The analysis was conducted using available course information. The validation identified two key aspects of the study that must be considered. First, syllabi were not crucial to the entire study, but could play a pivotal role depending on the topics in the course. Second, the analysis should be restricted slightly to include only core courses. The inclusion of electives into this study would provide multiple variations to each of the programs. The primary courses being taught represent the thrust of each of the engineering management programs. Electives would add a different flavor to the main theme of the programs being researched.

The research required an objective, non-biased view of the courses at the University of Alabama in Huntsville. The research focused on material given in course descriptions and was expanded to include syllabi. Validation of the course classifications was made through identification of characteristics from the data analyzed. Westbrook and Utley, engineering

management faculty at the University of Alabama in Huntsville, were involved in reviewing the analysis and validating justification of the classifications.

Initial verification of results was accomplished using the classification of courses according to the six schools of management thought. This initial method proved to be cumbersome due to the cross pollination of the six different schools of thought. As provided in Koontz's work, similarities existed among the schools of management thought. Management Process and Empirical were significantly related, and Human Behavior and Social Systems were significantly related. The decision was made to associate Mathematical and Decision Theory due to the heavy reliance of both schools on modeling, mathematics, decision analysis, and statistical methods. Combining the six schools of thought into three schools provided a cleaner analysis and a better understood classification of the materials analyzed.

Initial methods of analyzing the evidence of the schools of thought assigned equal weights to each one present in a course. After review, a weighting system for representing the primary thrust and associated influences of a course was devised. The primary thrust of the course would receive a weighting of one (1) point for scoring purposes. A secondary attribute of a course would be identified more than once or significantly in comparison to the primary topic and would be assigned a weight of one-half (½) of a point for scoring purposes. A tertiary attribute of a course would appear only once or sparingly in comparison to the primary topic and would be assigned a weight of one-quarter (¼) of a point for scoring purposes. The points for each course would then be analyzed for identification of findings.

The analysis methodology consisted of two forms, overall course analysis and individual program analysis. The analysis of all courses used the assigned weighted points for each school of management thought. The points were then summed to provide a relationship to identify the influence of the schools of management thought. The analysis of the individual programs used the assigned weighted points, but specifically calculated the points for courses directly involved

in a program. The points for the individual courses were summed for each school of thought to develop a classification for the engineering management and management of technology programs analyzed.

Chapter IV

FINDINGS

A. Introduction

The analysis of the data resulted in three major areas of study. The first method of analysis examined the overall number of times a classification was identified for all courses presented. This method provided the overall classification of the courses throughout the United States. The next method of analysis examined the courses within each program. By totaling the number of times a classification appeared within the program, an overall classification was assessed for each university's engineering management or management of technology program. The final method of analysis examined the classifications of the programs. This method identified the number of times a classification was listed as a major component of the program and an overall assessment was made.

Appendix B contains the results of the analysis of each course listed by university. Classification of the courses yielded multiple schools of thought throughout the engineering management and management of technology programs. Final analysis of the programs also provided programs with different schools of thought. One additional provision of the data analysis was to provide strong evidence of influence by other schools of thought within each of the programs. If the final point total for a school of thought was within one point of the leading school of thought, the program was considered to be strongly influenced by that school of thought.

B. Overall Course Findings

The total number of times a classification to a school of thought appeared in the analysis of courses is shown in Table 4.1. The total points for the classifications shown were calculated according to that described in the methodology. Management Process/Empirical appeared as a primary school of thought for courses 68 times, Human Behavior/Social Systems appeared as a primary school of thought for courses 24 times, and Mathematical/Decision Theory appeared as a primary school of thought for courses 73 times. Management Process/Empirical appeared as a secondary school of thought for courses 6 times, Human Behavior/Social Systems appeared as a secondary school of thought for courses 5 times, and Mathematical/Decision Theory appeared as a secondary school of thought for courses 5 times. Management Process/Empirical appeared as a tertiary school of thought for courses 21 times, Human Behavior/Social Systems appeared as a tertiary school of thought for courses 24 times, and Mathematical/Decision Theory appeared as a tertiary school of thought for courses 20 times.

School of Thought	Primary Emphasis (1 pt)	Secondary Emphasis (0.5 pt)	Tertiary Emphasis (0.25 pt)	Total Weighted Emphasis
Management Process/ Empirical	68	6	21	76.25
Human Behavior/Social Systems	24	5	24	32.50
Mathematical/Decision Theory	73	5	20	80.50

Table 4.1 Overall Course Findings and Weighted Points

Figure 4.1 provides a graphical interpretation of the results by percentage of the weighted total points for the classifications identified in the analysis. Mathematical/Decision Theory accounts for 45% of the weighted classifications, Management Process/Empirical

accounts for 38% of the weighted classifications, and Human Behavior/Social Systems accounts for 17% of the weighted classifications.

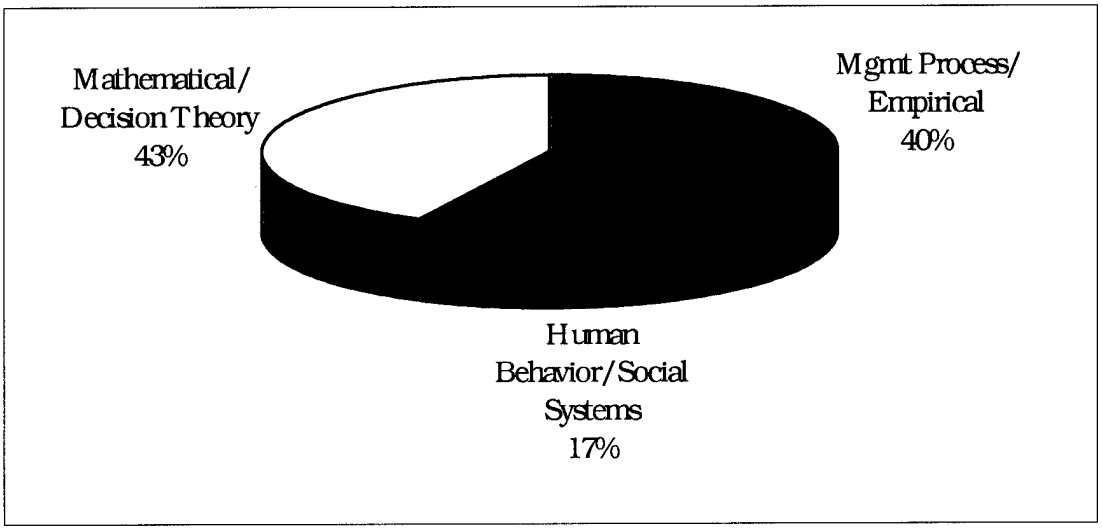

Figure 4.1 Percentage of Overall Course Weighted Points

C. Individual Program Findings

Appendix C, Table C.1 summarizes the complete results from the analysis and classification of each of the programs. The numbers provided in the individual program analysis verified the results from the overall course analysis. Discussion of the results from this analysis will focus on the weighted total points for each program.

Arizona State University had the following weighted total classifications for courses in its program: 3 for Management Process/Empirical, 1.25 for Human Behavior/Social Systems, and 4 for Mathematical/Decision Theory. The overall classification for Arizona State University is Mathematical/Decision Theory with a strong influence from Management Process/Empirical.

Florida Institute of Technology had the following weighted total classifications for courses in its program: 3.25 for Management Process/Empirical, 1 for Human Behavior/Social Systems, and 4 for Mathematical/Decision Theory. The overall classification for Florida Institute of Technology is Mathematical/Decision Theory with a strong influence from Management Process/Empirical.

George Washington University had the following weighted total classifications for courses in its program: 3 for Management Process/Empirical, 1 for Human Behavior/Social Systems, and 2.5 for Mathematical/Decision Theory. The overall classification for George Washington University is Management Process/Empirical with a strong influence from Mathematical/Decision Theory.

Kansas State University had the following weighted total classifications for courses in its program: 3 for Management Process/Empirical, 0.25 for Human Behavior/Social Systems, and 3.5 for Mathematical/Decision Theory. The overall classification for Kansas State University is Mathematical/Decision Theory with a strong influence from Management Process/Empirical.

Lamar University had the following weighted total classifications for courses in its program: 1 for Management Process/Empirical, 1.25 for Human Behavior/Social Systems, and 3.25 for Mathematical/Decision Theory. The overall classification for Lamar University is Mathematical/Decision Theory.

New Jersey Institute of Technology had the following weighted total classifications for courses in its program: 2.5 for Management Process/Empirical, 1 for Human Behavior/Social Systems, and 3.25 for Mathematical/Decision Theory. The overall classification for New Jersey Institute of Technology is Mathematical/Decision Theory with a strong influence from Management Process/Empirical.

New Mexico State University had the following weighted total classifications for courses in its program: 1.25 for Management Process/Empirical, 3.25 for Human Behavior/Social

Systems, and 2.25 for Mathematical/Decision Theory. The overall classification for New Mexico State University is Human Behavior/Social Systems with a strong influence from Mathematical/Decision Theory.

North Dakota State University had the following weighted total classifications for courses in its program: 4 for Management Process/Empirical, 0.25 for Human Behavior/Social Systems, and 3 for Mathematical/Decision Theory. The overall classification for North Dakota State University is Management Process/Empirical with a strong influence from Mathematical/Decision Theory.

Northeastern University had the following weighted total classifications for courses in its program: 1.25 for Management Process/Empirical, 0 for Human Behavior/Social Systems, and 5.5 for Mathematical/Decision Theory. The overall classification for Northeastern University is Mathematical/Decision Theory.

Old Dominion University had the following weighted total classifications for courses in its program: 3.25 for Management Process/Empirical, 1.25 for Human Behavior/Social Systems, and 5.75 for Mathematical/Decision Theory. The overall classification for Old Dominion University is Mathematical/Decision Theory.

Pennsylvania State University had the following weighted total classifications for courses in its program: 7.5 for Management Process/Empirical, 0.25 for Human Behavior/Social Systems, and 2.75 for Mathematical/Decision Theory. The overall classification for Pennsylvania State University is Management Process/Empirical.

Portland State had the following weighted total classifications for courses in its program: 3.5 for Management Process/Empirical, 1.75 for Human Behavior/Social Systems, and 3.25 for Mathematical/Decision Theory. The overall classification for Portland State University is Management Process/Empirical with a strong influence from Mathematical/Decision Theory.

The University of Alabama in Huntsville had the following weighted total classifications for courses in its program: 2.5 for Management Process/Empirical, 4.5 for Human Behavior/Social Systems, and 4 for Mathematical/Decision Theory. The overall classification for the University of Alabama in Huntsville is Human Behavior/Social Systems with a strong influence from Mathematical/Decision Theory.

The University of California at Davis had the following weighted total classifications for courses in its program: 9.25 for Management Process/Empirical, 4.25 for Human Behavior/Social Systems, and 7.75 for Mathematical/Decision Theory. The overall classification for the University of California at Davis is Management Process/Empirical.

The University of Dayton had the following weighted total classifications for courses in its program: 1.5 for Management Process/Empirical, 2 for Human Behavior/Social Systems, and 4.25 for Mathematical/Decision Theory. The overall classification for the University of Dayton is Mathematical/Decision Theory.

The University of Denver had the following weighted total classifications for courses in its program: 5.5 for Management Process/Empirical, 1.75 for Human Behavior/Social Systems, and 3.25 for Mathematical/Decision Theory. The overall classification for the University of Denver is Management Process/Empirical.

The University of Louisville had the following weighted total classifications for courses in its program: 2.25 for Management Process/Empirical, 0.5 for Human Behavior/Social Systems, and 3.25 for Mathematical/Decision Theory. The overall classification for the University of Louisville is Mathematical/Decision Theory with a strong influence from Management Process/Empirical.

The University of Missouri at Rolla had the following weighted total classifications for courses in its program: 9 for Management Process/Empirical, 1.75 for Human Behavior/Social

Systems, and 2.75 for Mathematical/Decision Theory. The overall classification for the University of Missouri at Rolla is Management Process/Empirical.

The University of South Florida had the following weighted total classifications for courses in its program: 3.5 for Management Process/Empirical, 1.75 for Human Behavior/Social Systems, and 3.25 for Mathematical/Decision Theory. The overall classification for the University of South Florida is Management Process/Empirical with a strong influence from Mathematical/Decision Theory.

The University of Tennessee at Knoxville had the following weighted total classifications for courses in its program: 4.25 for Management Process/Empirical, 1.75 for Human Behavior/Social Systems, and 3.25 for Mathematical/Decision Theory. The overall classification for the University of Tennessee at Knoxville is Management Process with a strong influence from Mathematical/Decision Theory.

Washington State University had the following weighted total classifications for courses in its program: 2 for Management Process/Empirical, 1.75 for Human Behavior/Social Systems, and 3 for Mathematical/Decision Theory. The overall classification for Washington State University is Mathematical/Decision Theory with a strong influence from Management Process/Empirical.

Appendix D, Table D.1 shows a matrix of the programs as classified. The top of the matrix indicates the influence from a school of thought, and the left side of the matrix indicates the primary school of thought. Schools along the diagonal of the matrix are identified as having only one school as the primary school of thought. Six programs appear within the box representing Mathematical/Decision Theory with strong influence from Management Process/Empirical. The next largest, four programs, appears in two locations at Management Process/Empirical with strong influence from Mathematical/Decision Theory and Mathematical/Decision Theory with strong influence from Management Process/Empirical. The

third largest, three programs, appears at the box representing Management Process/Empirical. The smallest number indicated, two programs, appears in the box representing Human Behavior/Social Systems with strong influence from Mathematical/Decision Theory.

D. Combined Program Findings

The number of times a management school of thought appeared as the primary school of thought for a program was determined from the individual program findings. The results of this analysis are shown in Table 4.2. The results of the primary schools of thought are 9 curriculums classified as Management Process/Empirical, 2 as Human Behavior/ Social Systems, and 10 as Mathematical/Decision Theory.

Primary School of Thought	Programs Classified
Management Process/Empirical	9
Human Behavior/Social Systems	2
Mathematical/Decision Theory	10

Table 4.2 Primary Classifications of Programs

A graphical interpretation of the results is shown in Figure 4.2. Mathematical/ Decision Theory School accounts for 47% of the primary school of thought for the programs, Management Process/Empirical accounts for 43% of the primary school of thought for the programs, Human Behavior/Social Systems accounts for 10% of the primary school of thought for the programs.

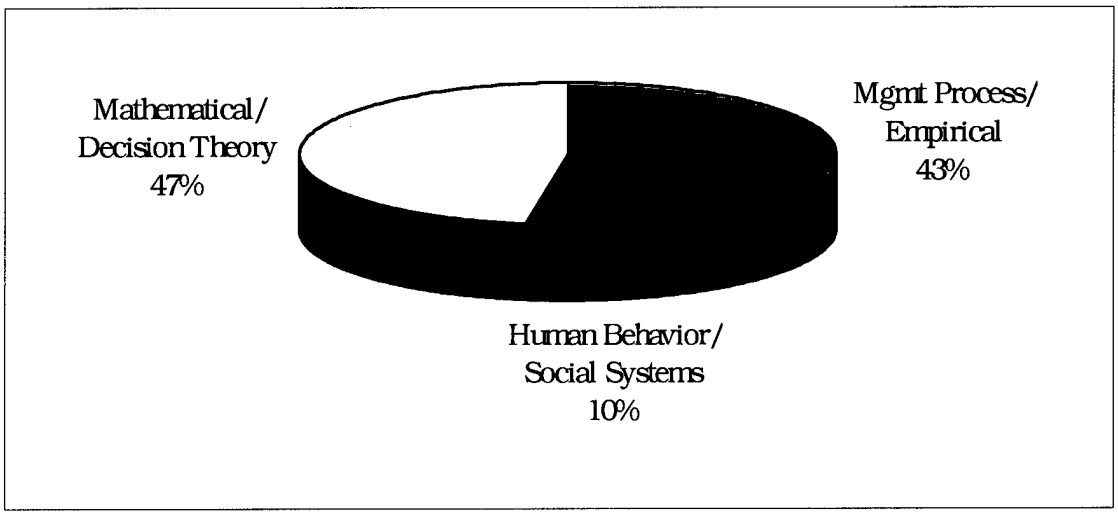

Figure 4.2 Percentage of Primary Classifications for Programs

Including the classifications identified as having a strong influence on the programs, the data results do not make a significant shift. The analysis including classifications of strong influence is shown in Table 4.3. The results are 15 programs classified with Management Process/Empirical, 2 with Human Behavior/Social Systems, and 17 with Mathematical/ Decision Theory.

Schools of Thought	Programs Classified
Management Process/Empirical	15
Human Behavior/Social Systems	2
Mathematical/Decision Theory	17

Table 4.3 Primary and Strong Influence Classifications of Programs

A graphical interpretation of the results is shown in Figure 4.3. The results are Mathematical/Decision Theory accounts for 50% of all the program classifications, Management

Process/Empirical accounts for 44% of all the program classifications, and HumanBehavior/Social Systems accounts for 6% of all the program classifications.

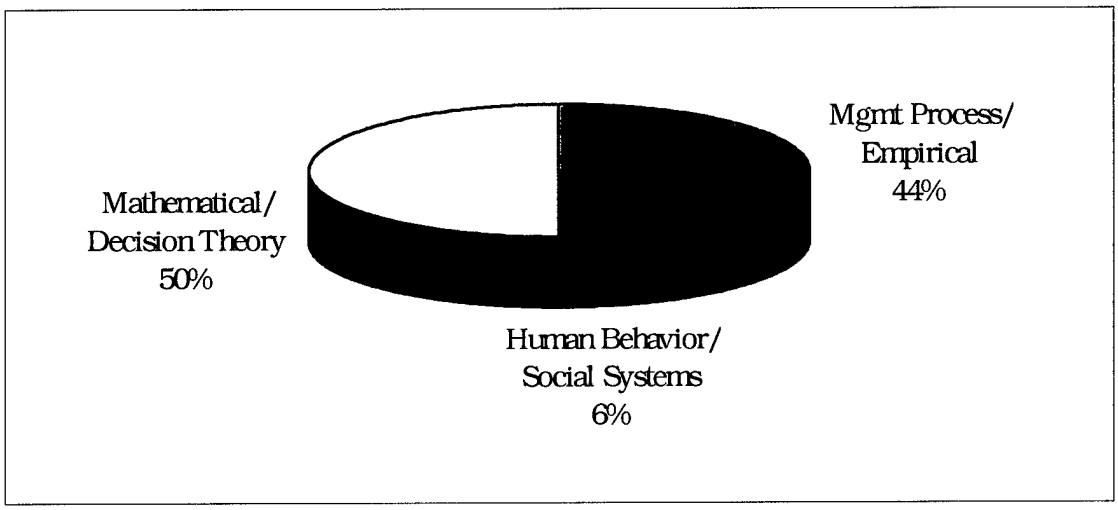

Figure 4.3 Percentage of Primary and Strong Influence Classifications for Programs

Chapter V

DISCUSSION AND CONCLUSIONS

A. Introduction

The hypothesis of this study was that the primary school of thought for the engineering management programs studied would be predominantly Mathematical/Decision Theory. As engineering management and technology management programs throughout the country become aware of this fact, they should be able to clearly see the skills and tools being taught to graduates and the impact they will have upon the industrial complex of the United States economy. The next question for consideration in further research should address whether the context in which we are educating our engineering management and management of technology graduates meets the expectations and needs of the current industrial base.

B. Discussion

The results of the overall findings as determined by all courses point to Mathematical/ Decision Theory as the primary school of management thought in use. The percentage calculated at 43% is 3% greater than Management Process/Empirical at 40%. Human Behavior/Social Systems at 17% of the total courses analyzed is not a primary emphasis of the combined engineering management and management of technology curriculums throughout the United States. By summing the individual program findings and comparing the results to the overall course findings, verification of the methodology and accuracy of the results was accomplished.

The results of the individual programs match the hypothesis of Mathematical/ Decision Theory as the leading school of thought in use today. The results, however, point to a significant use of Management Process/Empirical by the programs. In the analysis of the primary school of

thoughts in use, the evidence leans heavily towards Mathematical/Decision Theory at 47% of the responses. When the influencing schools of thought are included, Mathematical/Decision Theory increases only 3% to 50% of the classifications identified.

The classification matrix shows a predominance of the programs classified at the outside corners. There is very little use of the Human Behavior/Social Systems approaches in instructing engineering management and management of technology graduates. With only the University of Alabama in Huntsville and New Mexico State University showing a dependence upon this school of thought, the results from the analysis of courses are substantiated.

C. Conclusions

The primary school of thought employed by a majority of engineering management and management of technology programs is Mathematical/Decision Theory. The primary supporting school for the majority of these programs is Management Process/Empirical. The assumption made from this conclusion is that the programs have focused on optimization of processes and mathematical and economic models. The supporting areas of study are identified by the study of the functions of managers and the use of general principles.

The interpretation of this conclusion is beyond the scope of the research conducted in this study. The underlying issue is that many variations on the theme of engineering management exist. Are engineering management and management of technology curriculums being influenced by the reliance on Industrial and Systems Engineering departments? Are the curriculums the result of careful deliberation by the faculty? Are the curriculums limited by the faculty knowledge? If organizations employing engineering management and management of technology graduates were to be polled, what emphasis would they place on the various schools of management thought? Further study of the appropriate methods and techniques would present a better body of knowledge for further discussion. A factor impeding the identification of the one

"best" method for use in instructing graduates would have to be the use of the different approaches to management. Discussion by academia about the methods and tactics of instruction taught in engineering management and management of technology may be successful in identifying the appropriate methods to provide future success for the United States and its economy.

APPENDICES

APPENDIX A

Request for Information

March 30, 1998

Engineering Management Program
University Name
Address Line 1
Address Line 2
Attention: Head of Program
City, State ZIPXX-XXXX

The Engineering Management Department at the University of Alabama in Huntsville will be conducting research to identify the curriculums being taught to graduate engineering and technology managers throughout the United States. The purpose of the research will be to classify each engineering and technology management graduate program's courses according to the six schools of management thought. The analysis of the database collected will provide a benchmark for the current education of engineering and technology managers in the U.S.

In order to provide a fair and objective view of the data, we request your assistance in providing the appropriate information about your program. In particular, we request you forward the following information by April 30, 1998:

1) Requirements for the graduate program course of study.
2) Course descriptions for the required graduate courses.
3) Syllabi for the required graduate courses.
4) A point of contact for reference and questions (to include a phone number and electronic mail address).
5) Any additional pertinent information deemed necessary by your program.

In return for your assistance, the Engineering Management Department at the University of Alabama in Huntsville will forward a copy of the completed analysis before any publication is pursued. The data provided will not be released to other sources and will be used for academic purposes only. A listing of the engineering management programs to be evaluated is attached for your review. In an effort to identify appropriate engineering and technology management programs in the United States, Dr. Ted Eschenbach and Dr. Dundar F. Kocaoglu provided us with a listing of engineering and technology management programs worldwide.

For further information, the graduate research assistant for this topic is Capt. Phil Hicks. He is available for questions and comments at his office at the university, (205) 890-6636 or fax (205) 890-6608, or at his home, (205) 885-0214. Electronic mail can be sent to hicksp@bellsouth.net

I would personally like to thank you for your assistance in this endeavor. Please feel free to contact me at (205) 890-6976 for any questions.

Jerry D. Westbrook, Ph.D., P.E.
Professor and Chair
ISEEM

Attachment
Research List of Engineering and Technology Management Programs

Figure A.1 Request for Information from Programs

(1) Arizona State University

(2) Carnegie Mellon University

(3) Florida Institute of Technology

(4) George Mason University

(5) George Washington University

(6) Kansas State University

(7) Lamar University

(8) Mercer University

(9) National Technological University

(10) New Jersey Institute of Technology

(11) New Mexico State University

(12) North Dakota State University

(13) Northeastern University

(14) Old Dominion University

(15) Pennsylvania State University

(16) Portland State University

(17) University of Alabama in Huntsville

(18) University of Alaska -- Fairbanks

(19) University of California -- Davis

(20) University of Central Florida

(21) University of Dayton

(22) University of Denver

(23) University of Kansas

(24) University of Louisville

(25) University of Maryland

(26) University of Massachusetts

(27) University of Missouri -- Rolla

(28) University of South Florida

(29) University of Tennessee at Chattanooga

(30) University of Tennessee at Knoxville

(31) University of Texas at Arlington

(32) Virginia Polytechnic Institute and State University

(33) Washington State University

Figure A.2 Attachment of Programs for Research

APPENDIX B

Results of Course Analysis by Program

ARIZONA STATE UNIVERSITY
TECHNOLOGY MANAGEMENT CORE COURSES

Course	Evidence	School(s)
IE 552 Strategic Technical Planning	Concepts of Strategy, Strategy Formulation Process, and Strategic Planning Methodologies with Emphasis on Engineering Design and Manufacturing Strategy Complemented with Case Studies Analytical Executive Planning Support System is Presented and Used Throughout the Course	Management Process/Empirical
IEE 530 Enterprise Modeling	Focus on Social, Economic, and Technical Models of the Enterprise with Emphasis on the Management of Technological Resources Included are Organization, Econometric, Financial, and Large Scale Mathematical Models	Mathematical/Decision Theory
IEE 511 Analysis of Decision Processes	Methods of Making Decisions in Complex Environments and Statistical Decision Theory Effects of Risk, Uncertainty, and Strategy on Engineering Managerial Decisions	Mathematical/Decision Theory
IEE 532 Management of Technology	Designing a Technical Strategy Technological Forecasting Interfacing Marketing, Engineering, and Manufacturing Designing and Managing Innovation Systems Creativity Application of Basic Management Principles to Technology Management	Management Process/Empirical

Course	Evidence	School(s)
IEE 520 Ergonomics Design	Human Physiological and Psychological Factors in the Design of Work Environments and in the Employment of People in Man-Machine Systems	Management Process/Empirical Human Beh/Social Sys - 0.25
IEE 531 Topics in Engineering Administration	Consideration Given to Philosophical, Psychological, Political, and Social Implications of Administrative Decisions	Human Behavior/Social System
IEE 571 Quality Management	Economic-Based Acceptance Sampling, Multiattribute Acceptance Sampling, and Multivariate Statistics Emphasis on Fundamental Concepts and Applicability to Engineering Problems	Mathematical/Decision Theory
IEE 567 System Simulation	Use of Simulation in the Analysis and Design of Systems Involving Continuous and Discrete Processes Simulation Languages Statistical Aspects of Simulation	Mathematical/Decision Theory

FLORIDA INSTITUTE OF TECHNOLOGY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
BUS 5001 Managerial Accounting	Internal Reporting to Managers for use in Planning and Control Internal Reporting to Managers for use in Making Nonroutine Decisions Internal Reporting to Managers for use in Formulating Major Plans and Policies Cost-Volume-Profit Relationships Flexible Budgets and Standards Job Order and Process Cost Cost Allocation and Accumulation	Management Process/Empirical
BUS 5002 Corporate Finance	Concepts and Tools of Corporate Financial Management Corporate Financial Planning Forecasting Budgeting Quantitative Techniques and Practices Ethics International Aspects in Financial Decision Making	Mathematical/Decision Theory
BUS 5007 Intermediate Managerial Statistic	Application of Statistical Theory to Managerial Problems Methods of Statistical Inference for Management Decision Making F- and Chi-Square Distributions Nonparametric Tests Analysis of Variance Regression and Correlation Analysis	Mathematical/Decision Theory

Course	Evidence	School(s)
BUS 5013 Organizational Behavior	Contributions to Management Theory Made by Behavioral Sciences Better Understanding of the Human Being Individual and Group Behavior Aspects	Human Behavior/Social Systems
BUS 5133 Advanced Analytical Methods for Management	Quantitative Models Using Management Science/ Operations Research/Decision Science Techniques with Business Applications Linear Programming Inventory Models Queuing Models Markov Processes	Mathematical/Decision Theory
BUS 5019 Marketing	Role of Marketing in the Firm, the Economy, and Society Marketing Concepts and Operational Approaches for Marketing Decision Making Case Method Employed Extensively	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25
BUS 5024 Production and Operations Management	Translation of Product and Service Requirements into Facilities, Procedures and Operating Organizations Product Design Production Alternatives Facilities Location and Layout Resource Requirements Planning Quality Control	Management Process/Empirical

Course	Evidence	School(s)
ENM 5001 Total Quality Management/Quality Engineering	Basic Principles and Techniques Required to Achieve Total Quality in Manufacturing and Service Organizations Road Map or Structured Plan Approach for Establishing Quality Goals, Identification of Customers and Customer Needs, Measurement of Quality Objectives, and Development of Process Features and Controls for Improving Overall System Performance Case Studies and Projects Used to Illustrate Application of this Philosophy Across a Broad Range of Industrial and Service Settings	Management Process/Empirical

GEORGE WASHINGTON UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
EMgt 211 Organizational Behavior for the Engineering Manager	Organization and Orientation Dynamics of People and Organizations Models of Organizational Behavior Managing Communications Social Systems and Organizational Culture Motivational Basics Motivational Applications Appraising and Rewarding Performance Leadership	Human Behavior/Social Systems
EMgt 212 The Management of Technical Organization	Understanding the Practice of Management Within Technical Organizations Developing a Historical Perspective, Current Insight into Effective Managerial Style, Appropriate Research Findings, and Contemporary Case Studies Case Method is Primary Instruction Practice Thinking Like a Perceptive General Manager of a Technical Organization	Management Process/Empirical

Course	Evidence	School(s)
EMgt 254 Computer Systems in Information Management	Emphasis on Microcomputers and Network Hardware and Software Concepts Computers in Government Computers and Productivity Productivity Paradox Value Chain Model Role of Systems Analysis Information Engineering Computer Technology Building Blocks Software and Applications Data Communications Technologies Computer Networks Error and Bias Cognitive Engineering Privacy and Security Issues Knowledge-Based and Virtual Organizations	Management Process/Empirical
EMgt 260 Survey of Finance and Engineering Economics	Traditional Engineering Economy Fundamentals of Accounting Financial Planning, Budgeting, Estimating Applicable to Management of Technical Organizations	Mathematical/Decision Theory

Course	Evidence	School(s)
EMgt 269 Elements of Problem Solving and Decision Making for Managers	Formulate, Structure, Analyze, and Solve Complex Decision Problems Use of Influence Tree Diagrams for Modeling Decision Problems Bayesian Analysis Concept and use of Subjective Probability in the Role of Decision Criteria Value of Information Use of Probability Models for Solving Decision Problems Concept and use of Single- and Multi-Attribute Utility Functions	Mathematical/Decision Theory
Emgt 283 Systems Engineering I	Thirty Elements of Systems Engineering Requirements Engineering Systems Architecting Diagramming and Computer Tools Applications of Probability Theory to Systems Engineering Quantitative Relationships Scheduling and Costing Performance Analysis/ Simulation Risk and Decision Analysis	Management Process/Empirical Math/Decision Theory - 0.5

KANSAS STATE UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
IMSE 605 Advanced Industrial Management	Understand the Basic Elements of Decision Problems Skills for Modeling Decision Problems Tools Available for Analyzing Decision Models Understand Managerial Decision Making Process Under Conditions of Uncertainty and Risk Understand Decision Problems with Multiple Conflicting Objectives Skills to Represent Real-World Problems in Decision Models that can be Analyzed Using Decision Analysis Techniques	Mathematical/Decision Theory
IMSE 751 Applied Decision Theory	Normative, Prescriptive Methods for Analyzing Decision Situations Involving Certainty, Risk (Uncertainty), and Strict Uncertainty Non-Empirical Methods for Which There is Some Theoretical Foundation Assumptions Formulations and Correct Usage of Methods Rather Than Developing Theoretical Foundations	Mathematical/Decision Theory

Course	Evidence	School(s)
IMSE 805 Engineering Administration	Understanding of Special Problems Commonly Encountered in Managing People Involved in Creative Work Such as Engineering Design or Research Planning Organization Staffing and Training Creativity and Innovation Motivation Leadership Personality and Temperament Control of Projects Management of Research Management of Engineering Case Studies Used	Management Process/Empirical Hum Behavior/Social Sys- 0.25
IMSE 810 Industrial Logistics Engineering	Introduction of Models for Developing a Logistics Strategy and Making Logistical Decisions Logistics' Role in the Economy and the Firm Integrated Logistics Management Concept Management and Financial Analysis of Customer Service, Transportation, Warehousing, Inventory Management, Materials Management, and Purchasing Financial Control of Logistics Performance Organizing for Effective Logistics Strategic Logistics Plans	Management Process/Empirical Math/Decision Theory - 0.25

Course	Evidence	School(s)
IMSE 822 Advanced Engineering Economy	Cost Concepts Time Value of Money Equivalent Worth Rate of Return Alternative Comparison Payback Period Measures of Merit Depreciation After-Tax Analysis Capital Budgeting Math Programming for Capital Budgeting Estimating Economic Consequences Risk and Uncertainty Sensitivity Analysis Approaches to Risk, Risk Decision Criteria Decision Tree Analysis Multi-Attribute Decision Making Activity-Based Costing Personality and Temperament Control of Projects Management of Research Management of Engineering Case Studies Used	Mathematical/Decision Theory
IMSE 806 Engineering Project Management	Planning, Scheduling, and Controlling of Engineering Projects Project Team Cost/Benefit Analysis PERT/CPM Scheduling Techniques Reporting Computerized Management Tools	Management Process/Empirical Math/Decision Theory - 0.25

LAMAR UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
Egr 5369 Engineering Management	Decision Making Responsibilities Planning Organizing Staffing Technical Project Management Team Leadership Appraising Engineers	Management Process/Empirical Hum Behavior/Social Sys- 0.25
IE 432 Statistical Decision-Making for Engineers	Probability and Statistics	Mathematical/Decision Theory
IE 437 Operations Research	Operations Research	Mathematical/Decision Theory
IE 4315 Engineering Organization and Management	Use Management Systems to Classify Various Types of Organizations and Management Behavior	Human Behavior/Social System
Egr 5321 Quality Control Systems	Application of Statistical Methods to Industrial Problems Regression and correlation Theory Analysis of Variance Use of Control Charts for Control of Manufacturing Operations	Mathematical/Decision Theory
Egr 5366 Advanced Engineering Economics	Economic Analyses Based on Risk, Uncertainty, and Other Probabilistic Considerations Bayesian Attacks Influence of Perfect Information Competitive Decisions Decisions Under Pressure	Mathematical/Decision Theory

Course	Evidence	School(s)
Acc 530 Financial Accounting	Accounting Principles	Mathematical/Decision Theory
Eco 530 Foundations of Economics	Economics Principles	Mathematical/Decision Theory

NEW JERSEY INSTITUTE OF TECHNOLOGY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
Acct 615 Concepts of Strategic Cost Analysis]	Managerial Accounting – Break-Even Analysis, Alternate Choice Decisions, Profit Planning, and Transfer Pricing Strategic Cost Analysis Case Studies Emphasis on Using Managerial Accounting Data in Executive Planning and Control	Mathematical/Decision Theory Mgmt Process/Empirical - 0.5
EM 602 Management Science	Linear Programming Including Formulation, Methodology, and Application Transportation and Assignment Problems Markov Chains and Their Application in Decision Making Queuing Systems Deterministic and Stochastic Inventory Models	Mathematical/Decision Theory
HRM 601 Organizational Behavior	Individual Perception Learning Ability Conflict Resolution Models Group Process in Decision Making Motivation Problem Diagnosis Organization as the Mechanism for Joining Individuals and Groups into a Coherent Productive System Organizational Assessment for Innovation, Leadership Styles and Environmental Interaction	Human Behavior/Social System

Course	Evidence	School(s)
EM 636 Project Management	Planning and Controlling of Resources to Accomplish Specific Goals Time Cost Considerations Cash Flow Forecasting Financial and Performance Control Documentation	Management Process/Empirical
IE 673 Total Quality Management	TQM as Applicable to Industrial Systems Methods for Product Quality Improvement Prevention Through Quality Engineering and Design Extending Traditional Statistical Process Quality Control Supplier Management Quality Assurance Process Control Competitor Analysis Taguchi Methods Quality Functional Deployment ISO 9000 Baldridge Award	Management Process/Empirical Math/Decision Theory - 0.25
MIS 648 Decision Support	Decision Support Systems to Aid Management Decision Making in a Real-World Environment Establishing and Measuring Decision Support Systems Success Criteria Software Tools Model Management Elements of Artificial Intelligence and Statistics Justification, Design, and use of Decision Support Systems	Mathematical/Decision Theory

NEW MEXICO STATE UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
IE 523 Advanced Engineering Economy	Capital Investment Compound Interest (Discrete) Cash Flow (NFV, NPV, IRR) Independent Projects and Measure of Merit Mutually Exclusive Projects and Replacement Benefit/Cost Internal Rate of Return Capital Budgeting Taxation and Depreciation Uncertainty and Risk Capital Investment Public/Private Production Cost and Benefit Financial Statements	Mathematical/Decision Theory
IE 531 Survey of Operations Research Techniques	Formulation of Models Simplex Method Duality Sensitivity Analysis Transportation and Assignment Problems Integer Programming Projective Algorithms for Linear Programming Queuing Theory	Mathematical/Decision Theory
IE 563 Topics in Engineering Administration	Ethics Protecting Ideas (Patents, etc.) Information Risk Management Liability Employee (Ideas, Teams, etc.) Quality Small Business Innovation Process Management (Organization, Staff Role, MBO, etc.)	Management Process/Empirical Math/Decision Theory - 0.25 Hum Behavior/Social Sys- 0.25

Course	Evidence	School(s)
MGT 582 Organizational Change and Development	Change in Organizations Development of Organizations	Human Behavior/Social System
MGT 583 Leadership and Motivation	Motivation Concepts Nature and Importance of Leadership Traits, Motives, and Characteristics of Leaders Charismatic and Transformational Leadership Effective Leadership Behaviors and Attitudes Leadership Styles Contingency and Situational Leadership Power, Politics, and Leadership Influence Tactics of Leaders Developing Teamwork Motivating and Coaching Creative Problem Solving and Leadership Communication and Conflict Resolution International and Culturally Diverse Aspects Leadership of Quality and Technology Increasing Performance Effectiveness	Human Behavior/Social System

Course	Evidence	School(s)
MGT 514 Organizational Theory	Assess Mainstream Studies of Bureaucracy from Durkheim, Marx, Weber, Taylor, Hammer from the Vantage Point of Gender, Race, Ethnicity, Environment and Inequity (e.g. Child Labor, Slave Labor, Discrimination) Awareness of Several, Competing Approaches to Organizational Theory (Managerialist/Labor-Process, Actionist/Interpretative, Radical, Feminist, Racial/Ethnic, Ecology) Analyze Organizational Theory Texts and Formal Organizations in Terms of Gender, Race/Ethnicity, Nonsustainable, Mangerialist/Labor-Process, and Class Stereotypes and Orthodoxy Apply a Critical Theory Approach to Organizational Analysis	Human Behavior/Social System Mgmt Process/Empirical - 0.25

NORTH DAKOTA STATE UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
IME 761 Quality, Reliability, and Safety	Advanced Topics in Statistical Quality Control Sampling Plans Reliability Expert Systems in Quality Control	Mathematical/Decision Theory
IME 770 Advanced Operations Research	Theory & Applications of: Linear Programming Network Flows Nonlinear Programming	Mathematical/Decision Theory
IME 772 Advanced Simulation	Special Purpose Simulation Languages to Model, Analyze, and Design Industrial and Engineering Systems Stochastic and Deterministic Methods are Included	Mathematical/Decision Theory
IME 780 Advanced Production and Inventory	Theory & Applications of: Production Scheduling Inventory Management Production Planning Just-In-Time Production Materials Requirement Planning	Management Process/Empirical
IME 782 Robotics/CAD/CAM/ Control Systems	Continuum of Integrated Manufacturing Processes Where Computer Technology is Incorporated in the Conception, Design, Planning, and Fabrication of a Good or Service Philosophy and Methods of Systematically Building Flexible and Efficient Production Systems	Management Process/Empirical

Course	Evidence	School(s)
IME 711 Advanced Human Factors Engineering	Study and Application of Human Factors Concepts to Improve Worker Efficiency, Safety, and Well-Being in Industrial Work Environments. Emphasis on Modeling Man-Machine Interactions Related to Advanced Manufacturing Systems	Management Process/Empirical Hum Behavior/Social Sys- 0.25
IME 784 Computer Integrated Manufacturing	Study of the Continuum of Integrated Manufacturing Processes Where Computer Technology is Incorporated in the Conception, Design, Planning, and Fabrication of a Good or Service. Study of the Philosophy and Methods of Systematically Building Flexible and Efficient Production Systems	Management Process/Empirical

NORTHEASTERN UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
MIM 3400 Basic Probability and Statistics	Fundamental Concepts of Probability Events Samples Space Discrete and Continuous Random Variables Density Functions Mass Functions Cumulative Probability Distributions Moment Generating Functions Expectation of Random Variables Common Discrete and Continuous Probability Distributions Including Binomial, Poisson, Geometric, Uniform, Exponential, and Normal Multivariate Probability Distributions Covariance Independence of Random Variables Sampling and Descriptive Statistics Parameter Estimation Confidence Intervals Hypothesis Testing	Mathematical/Decision Theory
MIM 3530 Operations Research I	Introduction to the Theory and Use of Deterministic Models to Represent Industrial Operations Includes Linear Programming and Networks	Mathematical/Decision Theory

Course	Evidence	School(s)
MIM 3215 Engineering Economy	Economic Modeling and Analysis Techniques for Selecting Alternatives from Potential Solution to an Engineering Problem Measures of Merit Such as Present Worth, Annual Worth, Rate of Return, and Benefit/Cost Techniques Recent Techniques of Economic Analysis Especially Tools of Decision Making will be Examined Decisions Under Uncertainty are Explored	Mathematical/Decision Theory
MIM 3217 Engineering Project Management	Optimization of Schedules Utilizing Pertinent Software Tools Such as Linear Programming and Project Management Packages Gantt Charts PERT Diagrams Manpower Loading Charts Funding Charts Determination of Critical Path Comparison of Actual Performance with the Planned Schedule Systems Life Cycle Needs Analysis Requirements Definition Preliminary Design Detailed Design and Implementation	Management Process/Empirical Math/Decision Theory - 0.5

Course	Evidence	School(s)
MIM 3423 Applied Statistics	Develops Statistical Models for Analysis and Prediction of Random Phenomena Review of Descriptive Statistics and Hypothesis Testing Linear Models, Both Regression and ANOVA Chi-Squared and Non-Parametric Tests Introduction to Design of Experiments Emphasis on Applying Linear Models in Real Life Situations	Mathematical/Decision Theory
MIM 3207 Financial Management	Study of Issues and Processes of Short-Term Financing on Industrial Firms Financial Analysis of Cases, Supplemented by Readings to Develop Familiarity With Sources and Uses of Working Capital as Well as Goals and Problems Involved in its Management Analysis Necessary for Long-Term Financial Decisions such as Issuance of Stocks or Bonds, Contracting of Leases or Loans, Financing of a New Enterprise, Mergers, Capital Budgeting, Cost of Capital, and Valuation of a Business	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25

OLD DOMINION UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
420/520 Statistical Concepts in Engineering Management	Probability and Statistics Engineering Design Systems Analysis Manufacturing Quality Management Problems	Mathematical/Decision Theory Mgmt Process/Empirical - 0.5
600 Monetary Concepts in Engineering Management	Monetary Aspects of Engineering Projects Accounting Principles Financial Reports and Analysis Capital Budgeting Cost Estimation and Control Inventory Management Depreciation Investment Decisions	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25
602 Technological Data Analysis	Evaluation of Quantitative and Qualitative Data for Planning in a Dynamic Environment Baseline Forecasting Techniques (Smoothing, Decomposition, Regression, Time Series, Box-Jenkins) Growth Curves and Measures of Technology Use of Forecasting in Decision Models Model Building and Model Analysis	Management Process/Empirical Math/Decision Theory - 0.5
603 Deterministic Decision Methods	Optimization Methods and Deterministic Models for Decision Making Linear, Integer, and Non-Linear Programming Transportation, Assignment, and Inventory Models Network Techniques Sensitivity Analysis	Mathematical/Decision Theory

Course	Evidence	School(s)
604 Project Management	Design, Evaluation, Selection, Control, and Organization of Technical Projects Scheduling, Budgeting, Planning, and Monitoring Practices Software Tools Project Information Systems Proposal Preparation Strategic Issues Marketing of Technology Case Study Approach	Management Process/Empirical
607 Stochastic Decision Methods	Decision Analysis and Stochastic Models Risk and Uncertainty in Decision Making Dynamic Programming Monte Carlo Simulation of Dynamic Systems	Mathematical/Decision Theory
614 Quality Assurance Management	Integrated Analysis of the Quality Assurance Function Quality Deming's Way On-Line Quality Engineering Scientific Sampling Control Charts Acceptance Sampling Quality Cost Concept Economic Aspects of Quality Decisions	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25 Hum Behavior/Social Sys- 0.25

Course	Evidence	School(s)
601 Behavioral Concepts in Engineering Management	Inquiry into Behavioral Aspects of Engineering Project Teams Small Group Communication and Decision Making Leadership Motivation Performance Appraisal and Rewards Job Design Organizational Structure Conflict Resolution Case Studies and Group Exercises	Human Behavior/Social System Mgmt Process/Empirical - 0.25 Math/Decision Theory - 0.25

PENNSYLVANIA STATE UNIVERSITY
QUALITY AND MANUFACTURING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
QMM 491 Introduction to Business Concepts for Manufacturing	Topics in Accounting and Finance for Non-Business Students in Manufacturing Management Emphasizes Marketing, Accounting, and Finance Topics to Make Manufacturing Management Decisions Types of Manufacturing Operations (Job Shops, Repetitive, and Batch) Differences and Similarities Between Manufacturing and Service Operations Appreciate Importance of Manufacturing in Contemporary Society Market Planning Production Planning Managing Costs Facility and Capacity Decisions Standard Costing and Operating Performance Measures Measuring Financial Performance	Mathematical/Decision Theory Mgmt Process/Empirical - 0.5
QMM 492 Introduction to Engineering Design Principles	Engineering Principles Including Different Engineering Fields, Graphics, Design, Solid Modeling, and Failure Analysis Restricted to Non-Engineering Majors Design Projects Case Studies Competitive Analysis Through Product Dissection	Management Process/Empirical

Course	Evidence	School(s)
QMM 551 Quality Management	Design, Assessment, and Improvement of Quality Systems Customer Needs Analysis Identification of Opportunities for Application of Measurement Techniques Total Quality Management Systems Approach to Management by Designing and Continuously Improving Organizational Processes and Systems Course Designed Around In-Depth Readings and Cases	Management Process/Empirical Math/Decision Theory - 0.25 Hum Behavior/Social Sys- 0.25
QMM 552 Applied Statistical Process Control and Experimental Design	Concepts and Techniques of Statistical Process Control and the Design of Experiments	Mathematical/Decision Theory
QMM 561 Manufacturing Systems Planning and Control I	Systems, Components, and Configurations Flow of Material and Information in a Manufacturing System Supply Chain Management History of American Manufacturing Prosim III Forecasting Basics Inventory Control Concepts Material Requirements Planning Just in Time Methods Factory Physics: Objectives, Measures, and Controls Basic Factory Dynamics Variability and Its Influence Push Versus Pull Production Systems	Management Process/Empirical Math/Decision Theory - 0.25

Course	Evidence	School(s)
QMM 562 Manufacturing Systems Planning and Control II	Flow of Material and Information in a Manufacturing System Emphasis on System Integration Simulation as a Manufacturing Systems Analysis Tool Interrelationship Between Quality and Manufacturing System Operation Pull System Planning Shop Floor Control Production Scheduling Aggregate Planning Inventory Capacity Closure	Management Process/Empirical Math/Decision Theory - 0.25
QMM 581 Manufacturing Processes and Materials	Characteristics of Materials with Respect to Their Properties and Associated Choices of Processing to Create a Range of Products Develop Elementary Working Knowledge and Appreciation of Manufacturing Processes for Products Which Include Metals, Ceramics, Textiles, Foods, Polymers, and Pharmaceuticals Examine Influence and Interdependence of Material Properties and Processing and the Consequential Character of Various Products Examine Quality and Economic Implications Resulting from the Character of Manufacturing Processes on Various Materials Understand the Importance of Materials and Processes on Product Design	Management Process/Empirical

Course	Evidence	School(s)
QMM 571/572 Design Practice for Manufacturing I and II	Reinforce Business Concepts such as Market Analysis, Product Development Cycle Goal for the Course is to Develop a Marketable Product Line that can be Manufactured in a Profitable Manner	Management Process/Empirical
QMM 582 Manufacturing Strategy and Organization	Manufacturing Strategy Provides Direction to the Development of Capabilities that Support the Strategy of Business to Provide Sustainable Competitive Advantage Develop an Operations Manager's Strategic Perspective Acquire Skill in Identifying Key Operations Issues, Formulating Strategy, Guiding Management Decision-Making, and Predicting Operations Performance Understand the Influence of Ethical, Environmental, and Other Non-Economic Variables in Operations Decision Making	Management Process/Empirical

PORTLAND STATE UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
Emgt 520 Management of Engineering and Technology	Fundamental Concepts of Engineering and Technology Management In-Depth Understanding of the Underlying Principles of Engineering and Technology Management Innovation Process Technological Change Technological Organizations Motivation and Leadership Theories Applicable to Engineers and Scientists Engineering and R&D Projects Resource Management in Current and Emerging Technologies Strategic Management of Technological System Interfaces	Management Process/Empirical Hum Behavior/Social Sys- 0.25
Emgt 530 Decision Making in Engineering and Technology Management	Decision and Value Theory Concepts are Applied to Technical and Management Decisions Under Uncertainty Multicriteria Decisions are Analyzed Subjective, Judgmental Decisions are Quantified for Expert Decisions and Conflict Resolution in Strategic Decisions Involving Technological Alternatives Hierarchical Decision Modeling Approach Individual and Aggregate Decisions are Measured Decision Discrepancies and Group Disagreements are Evaluated Case Studies Included	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25

Course	Evidence	School(s)
Emgt 540 Operations Research in Engineering and Technology Management	Operations Research Techniques in Making Engineering Management Decisions Application and Interpretation of Linear Programming and Goal Programming Problem Formulations Mathematical Model Building Basic Principles Behind the Simplex Algorithm and Multiple Objective Linear Optimization Post Optimality Analysis from the Viewpoint of Technology Management Queuing Models	Mathematical/Decision Theory
Emgt 545 Project Management in Engineering and Technology	Critical Issues in the Management of Engineering and High Technology Projects Analysis of Time, Cost, Performance, Parameters from the Organizational, People, and Resource Perspectives Project Planning, Evaluation, and Selection Including Project Selection Models Project and Matrix Organizations Project Teams Scheduling with CPM/PERT Algorithms Budget and Schedule Control Termination of Projects Case Studies Used	Management Process/Empirical Hum Behavior/Social Sys- 0.25 Math/Decision Theory - 0.25

Course	Evidence	School(s)
Emgt 555 Technology Marketing	Special Issues Faced by Managers Marketing Technological Products in Markets Characterized by Rapid Environmental Change Examination of Marketing/ Engineering/Manufacturing Interface Product Innovation Strategies Value-Based Pricing Buyer Behavior and Strategic Selling Competitive Market Analysis and Positioning Distribution Strategies	Management Process/Empirical Hum Behavior/Social Sys- 0.25
Emgt 522 Communication and Team Building	Developing High Performance Teams for the Engineering-Driven Companies Fundamental Concepts that Make an Effective Team Building a High Performance Team Keys to High Performance Converting Risks to Assets The Power of Commitment, Discipline and Constructive Communication Getting Results Through Team Dynamics, Creative Problem Solving, and Measuring Team Performance	Human Behavior/Social System
Emgt 535 Engineering Economic Analysis	Economic Evaluation of Engineering and R&D Projects is Discussed from the Engineering Management Viewpoint Time Value of Money Tax Considerations Break-Even Sensitivity Analyses Project Evaluations Under Uncertainty, Risk Sharing, Capital Budgeting, and Multicriteria Decisions Case Studies Used	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25

UNIVERSITY OF ALABAMA IN HUNTSVILLE
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
EM 660 Engineering Management Theory	Comparison of Classical Management Principles and Theory with Environment, Goals, and Practices of High Technology, Research and Development, and Other Scientific-Engineering Organizations Cases Used to Illustrate Contemporary Problems and Environments Intro to Mgmt Theory Schools of Mgmt Thought Planning, Organizing, Staffing, Leading and Controlling Rational Model Bias for Action Close to Customer Autonomy and Entrepreneurship Simple Form Lean Staff Hands On, Value Driven Productivity Through People Stick to the Knitting Simultaneous Loose Tight Properties Zapp Laws of the 5th Discipline The Learning Organization Prototypes	Human Behavior/Social System Mgmt Process/Empirical - 0.5

Course	Evidence	School(s)
EM 662 Foundations of Total Quality Management	Basic Understanding of TQM in Context of Fundamental Building Blocks of Effective Management Measurement, Problem Solving, Continuous Improvement, Teamwork, Customer Focus, and Supportive Culture Culture Customers Teams Problem Solving Continuous Improvement Measurement MBNQA ISO 9000	Human Behavior/Social System Mgmt Process/Empirical - 0.25 Math/Decision Theory - 0.25
EM 666 Engineering Project Management	Management and Control of Multifaceted Engineering and Technological Projects Coordination and Interactions Between Client and Various Service Organizations Case Studies Illustrate Theories and Concepts Systems Thinking Organizational Structures Organizing and Staffing the Project Leadership in Project Management Team Building/Reward Systems Conflict/Working with Executives Planning Projects International Project Management Scheduling Projects; PERT/CPM Controlling Projects Risk Management	Management Process/Empirical Hum Behavior/Social Sys- 0.25 Math/Decision Theory - 0.25

Course	Evidence	School(s)
ISE 690 Statistical Methods for Engineers	Provide an Overview of Tools and Methodology of Statistics Descriptive Statistics Basic Probability Sampling Theory Standard Statistical Procedures Focus on Practical Application of These Methods for Both Estimation and Inference That Arise in Engineering and Scientific Work and with the Theory That Underlies the Methodology	Mathematical/Decision Theory
ISE 790 Advanced Statistical Applications	Introduction to Regression Modeling and Nonparametric Procedures Examine the Formulation, Properties, and Application of Linear Regression Models with One or More Predictor Variables, Including Model Selection Methods Nonparametric Procedures Complement Classical Procedures Based on Parametric (e.g., Normal Distribution) Assumptions which can be Employed in a Wider Variety of Settings Brief Discussion of Cluster Analysis	Mathematical/Decision Theory

Course	Evidence	School(s)
EM 760 Organization Structure and Motivation	Application of Motivational Theories in Technology Based Organizations Impact of Various Organization Structures in Relation to the Goals of the Organization Use and Effectiveness of Contemporary Organizational Structures Taylor Hawthorne Maslow McGregor Herzberg McClelland Vroom Porter and Lawler Theory Z Managerial Grid Likert Tannenbaum and Schmidt Hersey and Blanchard Max Weber Argyris Lawrence and Lorsch March and Simon Mintzberg Barnard Locke and Latham Kerr Likert Covey Drucker	Human Behavior/Social System Mgmt Process/Empirical - 0.25 Math/Decision Theory - 0.25

Course	Evidence	School(s)
EM762 Productivity and Quality in Engineering	Productivity and Quality Measures Defined and Used to Analyze Current Competitive Position of Important Sectors of American Industry with Respect to National and International Competition Global Productivity Issues Specific Foreign Country Issues National Productivity Issues Education Issues The Human Resource High Technology Industries Management Systems: Crosby, Deming, and Juran Management by Objectives Quality Circles, Quality Management, Reengineering, and Quality Functional Deployment Gainsharing Systems Statistical Process Control Just-In-Time Cellular Manufacturing Automation, Computer Integrated Manufacturing, Concurrent Engineering	Mathematical/Decision Theory Hum Behavior/ Social Sys- 0.5 Mgmt Process/Empirical - 0.25

Course	Evidence	School(s)
EM 766 Implementation of Technology	Challenges to Implementing Advanced Technology Equipment, Systems, and Methods in Engineering Organizations Justifying Technology Encouraging and Assimilating Change Changing Mgmt Roles Personnel Practices Organizational Structure Dealing with Impact of New Technologies on Business Policies and Strategic Planning Organizational Perspective Integrated Systems Preparing Infrastructure Formulating Supporting Human Resource Strategies Labor Relations and Advanced Technologies Case Studies	Human Behavior/Social System Mgmt Process/Empirical - 0.25 Math/Decision Theory - 0.25

UNIVERSITY OF CALIFORNIA - DAVIS
TECHNOLOGY MANAGEMENT CORE COURSES

Course	Evidence	School(s)
200A Financial Accounting	Concepts and Objectives Underlying the Preparation of Financial Statements Accounting Cycle Measurement and Valuation Problems Associated with Financial Statement Components Usefulness of Financial Statements in the Analysis of a Corporation's Operations	Mathematical/Decision Theory
200B Managerial Accounting	Systems and Techniques Used by Management for Decision Making and Control Within Organizations Planning for the Future Monitoring Results Achieved Taking Action in Response to Information Providing Incentives for Proper Actions Processes by Which Decisions are Made Budgetary Plans are Derived Reports are Developed and Used to Motivate Accounting Information for Decision Making	Management Process/Empirical Math/Decision Theory - 0.5

Course	Evidence	School(s)
201A The Individual and Group Dynamics	Basic Psychological and Social Psychological Processes Shaping Human Behavior Applies Knowledge of Processes to Problems of Working with and Managing Others in Organizations Motivation Job Design Commitment Socialization Culture Individual and Group Decision Making Team Building	Human Behavior/Social System
201B Organizational Structure and Strategy	Structure of Relations in Corporations and Not-For-Profit Organizations Structure Related to Effectiveness in Achieving Goals Various Structural Forms (Functional, Matrix, Divisions, Horizontal, Network) Organization's Competitive Environments Organizational Responses Technology and Organization Managing Organizational Culture and Change Analyzing Structural Problems	Human Behavior/Social System Mgmt Process/Empirical - 0.25

Course	Evidence	School(s)
202A Markets and the Firm	Interaction of Consumers, Firms and Government in Marketplace Effects of Interactions on the Use of Resources and Business Profits Managerial Perspective of Supply and Demand, Pricing Policy, and Strategic Analysis in Various Competitive Environments Marginal Analysis Opportunity Cost External Effects	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25 Hum Behavior/Social Sys- 0.25
202B Business, Government and the International Economy	Influence of Government and International Factors on the Business Environment Business Cycles Inflation and Interest Rates Federal Debt Monetary Policy International Trade and Finance	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25 Hum Behavior/Social Sys- 0.25
203A Data Analysis for Managers	Statistics and Data Analysis for Managerial Decision-Making Descriptive Statistics Principles of Data Collection Sampling Quality Control Statistical Inference Application of Data-Analytic Methods to Problems in Marketing, Finance, Accounting, Production, Operations, and Public Policy	Mathematical/Decision Theory

Course	Evidence	School(s)
203B Forecasting and Managerial Research Methods	Modern and Practical Statistical Methods for Managerial Decision Making Regression Analysis Time Series Analysis and Forecasting Design and Analysis of Experiments in Managerial Research Contingency Table Analysis Case Studies and Examples of Computer-Aided Analysis	Mathematical/Decision Theory
204 Marketing Management	Systematic Approach to Developing a Sound Marketing Plan Business Mission Situation Analysis Strategy Formulation Development and Implementation of Product, Pricing, Communication, and Distribution Policies Ethical Issues Facing Marketing Managers	Management Process/Empirical Math/Decision Theory - 0.25
205 Financial Theory and Policy	Fundamental Principles of Corporate Financial Management and Capital Markets General Valuation Methods for Risky Cash Flow Streams Asset Pricing Models Risk Management Equity Financing Debt Financing Dividend Policy	Mathematical/Decision Theory

Course	Evidence	School(s)
206 Decision Making and Management Science	Introduction to Modeling and Decision Analysis Introduction to Optimization and Linear Programming Modeling and Solving Linear Programming Problems Sensitivity Analysis and the Simplex Method Networks Integer Linear Programming Project Management Decision Analysis	Mathematical/Decision Theory
207 Management Information Systems	Strategic and Tactical Issues Related to Management of Information Systems Familiarity with Information System Technology and Its Management	Management Process/Empirical
240 Management Policy and Strategy	Analysis of Strategy Derivation of Strategic Plan for a Real Public-Sector or Private-Sector Organization External Environment (Competition, Market Characteristics, Government Regulatory Policies, Customer Demographics, Economic Climate, International Trends, and Societal Concerns) Internal Environment (Strengths and Weaknesses of the Client's Human and Capital Resources)	Management Process/Empirical Hum Behavior/Social Sys - 0.5

Course	Evidence	School(s)
281 Systems Analysis and Design	Considers the Design and Specifications of Information Systems Introduction to Systems Analysis and Design Entity-Relationship Diagrams Organizational Influence on Computer Use Systems and Management Concepts The Firm as a System The Environmental System Computer-Based Information Systems Data Flow Diagrams The Systems Approach to Problem Solving Systems Life Cycle Methodologies Project Planning and Control Network Diagrams Systems Analysis Economic Justification Systems Design Flowcharts Systems Security Systems Implementation	Management Process/Empirical
286 Telecommunications and Computer Networks	Considers Telecommunications and Computer Networks from a Managerial Perspective Industry Structure to Include Regulation, Divestiture, Deregulation, Products, Players, and Marketplace Technology and Managerial Applications to Include Local Area Networks, Private Branch Exchanges, Public Switched Networks, Public Data Networks, Bypass, and the Integrated Services Digital Network	Management Process/Empirical

Course	Evidence	School(s)
244 New and Small Business Ventures	Emphasizes Starting a New Business Venture or Managing a Small Business During Its Formative Stages Entrepreneurship Legal Issues Financing the Business Marketing Research The Management Team Small Teams of Students Develop a Detailed Business Plan for a Potential New Venture	Human Behavior/Social System Mgmt Process/Empirical - 0.5
250 Technology Management	Focuses on Issues in Management of Technology-Based Organizations Planning and Forecasting Productivity Improvement Quality Control Organization and Strategy Product Life Cycles Production Design Planning Management Valuation of Technology	Management Process/Empirical

Course	Evidence	School(s)
251 Management of Innovation	Covers the Management of Innovation in Industrial and Service Companies Product Life Cycle Product and Process Innovation Marketing-Innovation Interface Process Redesign Diffusion Theory Timing Sources of Innovation System Architecture Strategic Alliances Global Management Redesigning the Operations Processes (Reengineering) is Examined and Applied to Modern Innovative Organizations Explores and Applies the Concept of a Dominant Design Focuses on Management Skills such as Leadership, Competitive Strategic Planning, and Teamwork	Management Process/Empirical Hum Behavior/Social Sys - 0.25

UNIVERSITY OF DAYTON
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
ENM 505 Management of Engineering Systems I	Introduction to Functions and Tools of Engineering Management and Systems Engineering Process Roles and Relationships of Engineering Activities in the Total Enterprise Models and Techniques of Systems Analysis Engineering System Design Systems Management	Management Process/Empirical
ENM 521 Operations Research I	Deterministic Models and Methods of Operations Research Problem Formulation Mathematical Model Building Algorithmic Solution Procedures Linear, Integer, and Nonlinear Programming Network Analysis Deterministic Inventory Analysis	Mathematical/Decision Theory
ENM 522 Operations Research II	Probabilistic Models and Methods of Operations Research Risk and Uncertainty in the Decision Making Process Markov Processes Queuing Theory Stochastic Inventory Models Reliability Engineering Forecasting Simulation Modeling	Mathematical/Decision Theory

Course	Evidence	School(s)
ENM 582 Organizational Development in an Engineering Environment	Interpersonal and Group Skills Needed by the Engineering Manager Establishing Work Environments Which Allow for Communication, Trust, High Morale, Satisfaction, and Productive Group Activity TQM Implementation High Performing Teams	Human Behavior/Social System Mgmt Process/Empirical - 0.25 Math/Decision Theory - 0.25
ENM 585 Organizational Systems	Introduction to Organizational Theory and Practice With Emphasis on the Design of Organizational Structures for the Effective Integration of Production, Research and Development, and Engineering Activities High Performing Systems Technical Ad-Hoc Committee Matrix Organization Project Management	Human Behavior/Social System Mgmt Process/Empirical - 0.25
MSC 500 Probabilistic Methods I	Advanced Methods of Engineering Analysis for Engineering Managers and Management Scientists Operational Calculus Probability Modeling Statistical Analysis as Applied to Problems of Analysis and Design in Engineering Systems and Management Science	Mathematical/Decision Theory
MSC 501 Probabilistic Methods II	Advanced Methods of Engineering Analysis for Engineering Managers and Management Scientists Linear Algebra Inferential and Experimental Statistics as Applied to Problems of Analysis and Design in Engineering Systems and Management Science	Mathematical/Decision Theory

UNIVERSITY OF DENVER
TECHNOLOGY MANAGEMENT CORE COURSES

Course	Evidence	School(s)
MOTM 4100 Technology and the Organization	Dynamics of Technology Advances Role of Technology in Business Enterprise Technology and Product Life Cycles Strategic and Operational Issues in Managing Technology and Technology Intensive Organizations Critical Success factors in Managing Technology Research vs. Development Nurturing Technology Innovation	Management Process/Empirical Hum Behavior/Social Sys- 0.25
MOTM 4102 Technology in the Global Environment	Impact of Globalization on Technology Innovation and Diffusion Interpret Technology Activities of Firms and Government in Their Global Context Analyze Their Likely Impact on Technology Choices and Opportunities	Mathematical/Decision Theory
MOTM 4103 Public Policy and Regulatory Requirements in Technology Management	External Business Environment Within which the Technology Driven Business Must Function Government Incentives and Constraints; Impact on Development of Products, Processes, and Markets Examine the Way Policy and Regulatory Issues Take Affect Looks at Issues Involved in Formulating business Strategy and Plans Within the Constraints and Opportunities Offered by Public Policy	Management Process/Empirical Hum Behavior/Social Sys- 0.25

Course	Evidence	School(s)
MOTM 4302 Capital Resource Allocation in Technology Intensive Industries	Efficient and Effective Allocation of Resources Difficulties Inherent in Quantifying Costs and Benefits Evaluate Technology-Based Initiatives According to their Economic and Financial Feasibility as Well as Their Strategic Fit Within the Organization	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25
MOTM 4325 Technology Forecasting and Assessment	Forecasting Direction and Rate of Technological Advance Normative and Extrapolative Techniques for Predicting Future Directions and Likely Developments in a Given Technology	Mathematical/Decision Theory
MOTM 4330 Marketing and Technology	Competition in High Technology Industries Globalization of Markets Techniques for Forecasting Demand for Technology Based Products and Services Managing Customer Relations and the Channels of Distribution for High Technology Products	Management Process/Empirical Math/Decision Theory - 0.25
MOTM 4345 Contract Negotiation and Administration	Bargaining for Internal Resource Allocations Making Agreements With Vendors, Joint Venture Partners, and Customers Strategies to Minimize Conflict in Contracting With Government and Private Sector Firms Basic Principles of Contract Law Investigate Negotiating Techniques that Reduce Significant Problems in Contract Administration	Management Process/Empirical Hum Behavior/Social Sys- 0.25

Course	Evidence	School(s)
MOTM 4360 Business Plans for Technology Ventures	Ability to Construct a Business Plan Product Life Cycles Capital Requirements Staffing Growth Projections Management Experience	Management Process/Empirical
UCIN 4500 Leading Organizational Change	Explore Concepts and Skills Required for Effective Change Management Breakpoint Change Stages of Individual and Organizational Change Essential Relationships Between Leadership and Management Assorted Organizational and Management Models for Managing Change Examine and Engage in the Processes of Strategic Planning and Creating Directed Change	Human Behavior/Social System Mgmt Process/Empirical - 0.25

UNIVERSITY OF LOUISVILLE
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
EM 515 Operations Research I: Deterministic Models	Application of Mathematical Modeling and Network Analysis Techniques to Resolve Engineering Management Problems Linear, Integer, Dynamic, and Nonlinear Programming Network Analysis Scheduling PERT/CPM	Mathematical/Decision Theory Mgmt Process/Empirical - 0.25
EM 570 Engineering Economic Analysis	Engineering Decision Making Time Value of Money Compounding Interest Equivalence Analyzing a Project (PW/AW) Rate of Return Incremental Analysis Benefit Cost Ratio/Payback Period Depreciation Income Tax	Mathematical/Decision Theory
EM 590-75 Engineering Probability and Statistics	Fundamentals and Application of Probability and Statistics for Engineering Management and Business Decision Making Statistical Thinking Methods Descriptive Statistics Basic Probability Theory Probability Distributions Statistical Inferences Hypothesis Testing Regression Analysis	Mathematical/Decision Theory

Course	Evidence	School(s)
EM 660 Engineering Management Information and Control Systems	Behavioral and Organizational Concepts Management Information Systems Databases Relational Algebra and Calculus Statistical Quality Control Object-Oriented Databases Deductive, Network, and Hierarchical Databases Database Design Dependency Analysis	Management Process/Empirical Math/Decision Theory - 0.25 Hum Behavior/Social Sys- 0.25
EM 683 Project Management	Creativity and Idea Generation Technological Forecasting Project Selection Project Manager Project Organization Project Planning Negotiation and Conflict Resolution Budgeting and Cost Estimation Scheduling Resource Allocation Monitoring and Information Systems Project Control Project Auditing Project Termination Multicultural, Environmental, and Unsolved Issues	Management Process/Empirical Hum Behavior/Social Sys- 0.25

UNIVERSITY OF MISSOURI - ROLLA
TECHNOLOGY MANAGEMENT CORE COURSES

Course	Evidence	School(s)
Eng Mg 313 Human Relations in Technical Management	Human Behavior in Technical Managerial Situations Influencing and Motivating Performance Improving Morale and Discipline Self-Appraisal and Analysis	Human Behavior/Social System
Eng Mg 314 Management for Engineers	Transition of the Engineer to Manager Planning and Organizing Technical Activities Selecting and Managing Projects Team Building and Motivation Techniques of Control and Communication Time Management	Management Process/Empirical Hum Behavior/Social Sys- 0.25
Eng Mg 320 Technical Entrepreneurship	Student Teams Develop a Complete Business Plan for a Company to Develop, Manufacture, and Distribute Real Technical/Product Service Lectures and Business Fundamentals Patents Market/Technical Forecasting Legal and Tax Aspects Venture Capital	Management Process/Empirical

Course	Evidence	School(s)
Eng Mg 327 Legal Environment	Study of the Effect of the Legal Environment on the Decisions which the Engineering Manager Must Make Course Investigates the Social Forces that Produced this Environment and the Responsibilities Incumbent upon the Engineer	Management Process/Empirical Hum Behavior/Social Sys- 0.25
Eng Mg 328 Government Regulations; Business and Industry	Course Presents the Administrative Process of Government and its Present Day Relationships to the Business and Industrial World through Regulations	Management Process/Empirical
Eng Mg 332 Engineering Cost Accounting	Analysis and Design of Job, Process and Standard Cost Accounting Methods in Manufacturing Environment, Interrelationship of Cost Accounting Methods, and Justification of Automation in a Technological Setting	Mathematical/Decision Theory
Eng Mg 333 Management Information Systems	Study of the Operational and Managerial Information Needs of an Organization Emphasis on the Information Needed Throughout an Organization and on Information Systems to Meet Those Needs	Management Process/Empirical
Eng Mg 351 Industrial Marketing Systems Analysis	Analysis of the Factors of Engineered Products, Customers, Communication, Promotion, Personal Selling, Persuasion, and Management within a Dynamic Industrial Sales Environment	Management Process/Empirical

Course	Evidence	School(s)
Eng Mg 361 Project Management	Organization Structure and Staffing Motivation, Authority, and Influence Conflict Management Project Planning Network Systems Pricing, Estimating, and Cost Control Proposal Preparation Project Information Systems International Project Management	Management Process/Empirical Hum Behavior/Social Sys- 0.25 Math/Decision Theory - 0.25
Eng Mg 451 Advanced Marketing Management	Study of Marketing Decision Areas in the Technically Based Firm Includes Product Selection and Development, Marketing Research Market Development, Distribution, Advertising, and Promotion Pricing Policies Including Legal Aspects and Problems in Selecting, Training and Controlling Field Sales Force Examination of Interaction within Consumer and Industrial Marketing Environments	Management Process/Empirical
Eng Mg 452 Advanced Financial Management	Principles of Financial Organization and Management in Technological Enterprise Demands for Funds Internal and External Supply of Funds Budgetary Control Reserve and Dividends Policy Emphasizes Systems Approach and Problems of Engineering Design and Automation as they Influence Financial Decisions	Management Process/Empirical Math/Decision Theory - 0.5

Course	Evidence	School(s)
Statistics/Mathematical Modeling	Study of Statistical Methods and Mathematical Modeling	Mathematical/Decision Theory

UNIVERSITY OF SOUTH FLORIDA
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
EIN 5322 Principles of Engineering Management	Management and Productivity Perspectives on Management Fundamentals of Planning Strategic Management Fundamentals of Organizing Corporate Culture Nature of Leadership Leading Through Motivation Leading Through Teamwork Innovation and Change Importance of Controlling Managing With Ethics and Social Responsibility	Management Process/Empirical Hum Behavior/Social Sys - 0.5
ESI 5306 Operations Research for Engineering Management	Classical Modeling and Optimization Linear Programming Network Models Simulation Modeling Decision Analysis PERT/CPM Queuing Models	Mathematical/Decision Theory
EIN 5357 Engineering Value Analysis	Statistical Models for Analyzing Engineering Alternatives from an Economical Viewpoint Use of Advanced Engineering Economy Concepts in Solving Industrial Problems	Mathematical/Decision Theory

Course	Evidence	School(s)
EIN 6319 Work Design and Productivity Engineering	Foundations of Motivated Work Performances, Job Satisfaction, and Organizational Productivity Analysis of Job Content and Job Context Motivation and Productivity Division of Labor (Smith) Bureaucracy (Weber) Scientific Management (Taylor) Motion and Time Study (Frank and Lillian Gilbreth) Communism (Marx) Administrative Theory (Fayol) Hawthorne Experiments (Mayo) Functions of Executives (Barnard) Hierarchy of Needs (Maslow) Theory X and Y (McGregor) Behavior A and B (Greenhalgh) Motivation-Hygiene Theory (Herzberg) Job Characteristics Model (Hackman and Oldham) Expectancy Theory (Vroom) Reward Theory (Porter and Lawler) Equity Theory (Adams) What Managers Do (Mintzberg) Acquired Needs Theory (McClelland) Design of Work for Groups (Cummings)	Human Behavior/Social System Mgmt Process/Empirical - 0.5 Math/Decision Theory - 0.25

Course	Evidence	School(s)
EIN 6323 Engineering Management Policy and Strategy	Strategic Planning and Policy Formulation in Technical and Scientific Organizations Translation of Strategic Plans into Action Plans and Implementation of the Strategic Change Process Strategic Management Company Mission Environmental Issues Internal Analysis Financial Analysis Long Term Objectives Choosing a Strategy Implementing Strategy - Functions Implementing Strategy - People Evaluating Strategy	Management Process/Empirical Hum Behavior/Social Sys- 0.25
ESI 5219 Statistical Methods for Engineering Managers	Statistical Methods Applied to Engineering Management Problems Involving Estimation and Prediction Under Conditions of Uncertainty	Mathematical/Decision Theory
EIN 6386 Problems in Engineering Management	Case Studies of Problems Encountered by Technical Managers in the Planning, Organizing, Directing, and Controlling of Resources in Technology-Based Organizations Operations Management Strategies, Forecasting Products, Services, Processes Facility Location Layout Planning Job Design, Standards, and Work Measurement Scheduling Inventory Control Fundamentals Inventory Control Applications	Management Process/Empirical

UNIVERSITY OF TENNESSEE - KNOXVILLE
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
IE 516 Statistical Methods in Industrial Engineering	Application of Classical Statistical Techniques to Industrial Engineering Problem Applications Statistics Statistical Thinking in the Managerial Context of Organizational Improvement Relationship Between Statistical Process Control Techniques and Classical Tools Parameter Estimation Hypothesis Testing Goodness-of-Fit Testing Linear Regression Correlation Analysis of Variance Single and Multiple Factor Experimental Design	Mathematical/Decision Theory
IE 518 Advanced Engineering Economy	Application of Engineering Economic Analysis in Complex Decision Situations Inflation and Price Changes Uncertainty Evaluation Using Nonprobalistic Techniques Capital Financing and Project Allocation Evaluations Involving Equipment Replacement, Investor-Owned Utilities, and Public Works Projects Probabilistic Risk Analysis Including Computer Simulation and Decision Trees Multiattributed Decision Analysis	Mathematical/Decision Theory

Course	Evidence	School(s)
EM 537 Analytical Methods for Engineering Managers	Survey of Management Analysis and Control Systems Through IE Techniques Qualitative and Quantitative Systems Methods Analysis Work Measurement Incentive Systems Wage and Salary Development Production and Inventory Control Facility Layout Linear Programming Applied Operations Research Techniques	Management Process/Empirical Math/Decision Theory - 0.25
IE 522 Optimization Methods in Industrial Engineering	Classical Optimization Theory Unidimensional and N-Dimensional Search Techniques Lagrangean Relaxation Separable Programming Linearization Techniques Quadratic Programming Dynamic Programming	Mathematical/Decision Theory
EM 531 Motivation and Culture in Engineering Management	Motivational Theories and Practice to Improve Individual and Organizational Capabilities Success in Meeting Goals Improving Theories and Practice to Improve Individual and Organizational Capabilities Improving Creativity/ Innovation Leadership and Personal Interrelationship Skills Improvements Through Organizational Structure, Policies, and Work Design	Human Behavior/Social System Mgmt Process/Empirical - 0.25

Course	Evidence	School(s)
EM 533 Theory and Practice of Engineering Management	Manager's Perspective Business Definition Strategic Planning and Management Marketing and Competition in a Global Economy Finance Organization Systems Thinking Team Building Corporate Culture and Leadership in the New Organization Quality, Empowerment, and Learning Organizations	Management Process/Empirical Hum Behavior/Social Sys - 0.5
EM 536 Project Management	Development and Management of Engineering and Technology Projects Project Proposal Preparation Resource and Cost Estimating Project Planning, Organizing, and Controlling (Including Network Diagrams and Other Techniques) Role of the Project Manager Including Team Building, Conflict Resolution, and Alternative Solutions Discussion of Typical Problems and Alternative Solutions	Management Process/Empirical Hum Behavior/Social Sys- 0.25
EM 539 Strategic Management in Technical Organizations	Strategic Planning Process and Strategic Management in Practice Corporate Vision and Mission Product, Market, Organizational, and Financial Strategies External Factors Commercialization of New Technologies Competition and Beyond	Management Process/Empirical

WASHINGTON STATE UNIVERSITY
ENGINEERING MANAGEMENT CORE COURSES

Course	Evidence	School(s)
EM 501 Management of Organizations	Explores Issues Dealing with Individual Behavior in Work Organizations Learn Various Approaches to Motivation, Leadership, and Team-Building Key Focus on Team Management Skills: How to Organize Groups for Maximum Effectiveness, How to Motivate Group Members, and How to Promote and Reward Team Success	Human Behavior/Social System
EM 505 Financial Management for Engineers	Financial Implications of Design, Manufacture, Construction, Sales, and Company Strategic Plan Engineering and Cost Accounting at Odds Smart Approach to Finance, Its Implications to Technical Processes, and Financial Management of the Technical Firm	Mathematical/Decision Theory
EM 540 Operations Research for Managers	Applying Linear, Integer, Goal Programming Network Optimization Queuing Analysis Dynamic Programming Simulation Markov Analysis Forecasting to Engineering Management Decisions Mathematical Models	Mathematical/Decision Theory

Course	Evidence	School(s)
EM 564 Project Management	Examine Technical Tools (CPM, PERT, Cost and Schedule Control Systems) Behavioral Issues Considerations of Org Struct Project Selection Chartering at the Highest Managerial Levels Day-To-Day Skills for the Project Manager Meaningful Contribution and Participation for Project Team Members	Management Process/Empirical Hum Behavior/Social Sys - 0.5
EM 591 Strategic Planning of Technology and Innovations in Engineering	Concepts, Techniques, and Processes of Management with Direction and Purpose Manager Responsible for the Long-Term Health of the Enterprise. Use of Technology for Competitive Advantage Interaction of Technology with Other Strategic Variables Formulation of Strategic Decisions Management of Strategic Processes Dealing with Analytical, Behavioral, and Creative Aspects of Management	Management Process/Empirical Hum Behavior/Social Sys- 0.25
Stat 430 Statistical Methods in Engineering	Problems and Dealing with Certainty and Uncertainty Implementation and Use Fits Uncertainty Course Deals with Uncertainty and Decision Making Read and Interpret Statistical Literature Apply Basic Statistical Methods in Evaluating Data	Mathematical/Decision Theory

APPENDIX C

Individual University Findings

University	Primary School of Thought			Secondary School of Thought			Tertiary School of Thought			Total Weighted Points Assigned			Overall
	Mgmt Process/Emp	Hum Beh/ Soc Sys	Math/Dec Theory	Mgmt Process/Emp	Hum Beh/ Soc Sys	Math/Dec Theory	Mgmt Process/Emp	Hum Beh/ Soc Sys	Math/Dec Theory	Mgmt Process/Emp	Hum Beh/ Soc Sys	Math/Dec Theory	
Arizona State University	3	1	4	0	0	0	0	1	0	3	1.25	4	Mathematical/Decision Theory (Strong Influence from Management Process/Empirical)
Florida Institute of Technology	3	1	4	0	0	0	1	0	0	3.25	1	4	Mathematical/Decision Theory (Strong Influence from Management Process/Empirical)
George Washington University	3	1	2	0	0	1	0	0	0	3	1	2.5	Management Process/Empirical (Strong Influence from Mathematical/Decision Theory)
Kansas State University	3	0	3	0	0	0	0	1	2	3	0.25	3.5	Mathematical/Decision Theory (Strong Influence from Management Process/Empirical)
Lamar University	1	1	6	0	0	0	0	1	0	1	1.25	6	Mathematical/Decision Theory
New Jersey Institute of Technology	2	1	3	1	0	0	0	0	1	2.5	1	3.25	Mathematical/Decision Theory (Strong Influence from Management Process/Empirical)
New Mexico State University	1	3	2	0	0	0	1	1	1	1.25	3.25	2.25	Human Behavior/Social Systems (Strong Influence from Mathematical/Decision Theory
North Dakota State University	4	0	3	0	0	0	0	1	0	4	0.25	3	Management Process/Empirical (Strong Influence from Mathematical/Decision Theory)
Northeastern University	1	0	5	0	0	1	1	0	0	1.25	0	5.5	Mathematical/Decision Theory
Old Dominion University	2	1	5	1	0	1	3	1	1	3.25	1.25	5.75	Mathematical/Decision Theory
Pennsylvania State University	7	0	2	1	0	0	0	1	3	7.5	0.25	2.75	Management Process/Empirical
Portland State University	3	1	3	0	0	0	2	3	1	3.5	1.75	3.25	Management Process/Empirical (Strong Influence from Mathematical/Decision Theory)
University of Alabama in Huntsville	1	4	3	1	1	0	4	0	4	2.5	4.5	4	Human Behavior/Social Systems (Strong Influence from Mathematical/Decision Theory
University of California - Davis	8	3	7	1	1	1	3	3	1	9.25	4.25	7.75	Management Process/Empirical
University of Dayton	1	2	4	0	0	0	2	0	1	1.5	2	4.25	Mathematical/Decision Theory
University of Denver	5	1	3	0	0	0	2	3	1	5.5	1.75	3.25	Management Process/Empirical
University of Louisville	2	0	3	0	0	0	1	2	1	2.25	0.5	3.25	Mathematical/Decision Theory (Strong Influence from Management Process/Empirical)
University of Missouri - Rolla	9	1	2	0	0	1	0	3	1	9	1.75	2.75	Management Process/Empirical
University of South Florida	3	1	3	1	1	0	0	1	1	3.5	1.75	3.25	Management Process/Empirical (Strong Influence from Mathematical/Decision Theory)
University of Tennessee - Knoxville	4	1	3	0	1	0	1	1	1	4.25	1.75	3.25	Management Process/Empirical (Strong Influence from Mathematical/Decision Theory)
Washington State University	2	1	3	0	1	0	0	1	0	2	1.75	3	Mathematical/Decision Theory (Strong Influence from Management Process/Empirical)
Totals	68	24	73	6	5	5	21	24	20	76.25	32.5	80.5	

Table 4.2 Individual Program Findings, Weighted Points, and Classification

APPENDIX D

Classification Matrix

Primary School	Strong Influence From		
	Mgmt Process/Empirical	Hum Behavior/Social Sys	Math/Decision Theory
Mgmt Process/ Empirical	University of California - Davis Pennsylvania State University University of Denver University of Missouri - Rolla		George Washington University North Dakota State University Portland State University University of Tennessee - Knoxville
Hum Behavior/ Social Sys			New Mexico State University University of Alabama in Huntsville
Math/ Decision Theory	Arizona State University Florida Institute of Technology Kansas State University New Jersey Institute of Technology University of Louisville Washington State University		Lamar University Northeastern University Old Dominion University University of Dayton

Table D.1 Classification Matrix

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