5-15-1986

Curricular Report No. 1985-86-6A from the Graduate Council to the Faculty Senate: Proposal for a M.S. Program in manufacturing Engineering

University of Rhode Island Faculty Senate

Serial Number #85-86--35

THE UNIVERSITY OF RHODE ISLAND
Kingston, Rhode Island

FACULTY SENATE
BILL

Adopted by the Faculty Senate

TO: President Edward D. Eddy

FROM: Chairperson of the Faculty Senate

1. The attached BILL, titled Curricular Report No. 1985-86-6A from the Graduate Council to the Faculty Senate: Proposal for a M.S. Program in Manufacturing Engineering, is forwarded for your consideration.

2. The original and two copies for your use are included.

3. This BILL was adopted by vote of the Faculty Senate on May 15, 1986 (date).

4. After considering this bill, will you please indicate your approval or disapproval. Return the original or forward it to the Board of Governors, completing the appropriate endorsement below.

5. In accordance with Section 10, paragraph 4 of the Senate's By-Laws, this bill will become effective June 5, 1986, three weeks after Senate approval, unless: (1) specific dates for implementation are written into the bill; (2) you return it disapproved; (3) you forward it to the Board of Governors for their approval; or (4) the University Faculty petitions for a referendum. If the bill is forwarded to the Board of Governors, it will not become effective until approved by the Board.

May 16, 1986 (date)

Richard Katula
Richard Katula
Chairperson of the Faculty Senate

ENDORSEMENT

TO: Chairperson of the Faculty Senate

FROM: President of the University

Returned.

a. Approved ____.

b. Approved subject to final approval by Board of Governors ✓.

c. Disapproved ____.

June 3, 1986 (date)

Edward D. Eddy
President

Form revised 4/86

CURRICULAR REPORT FROM THE GRADUATE COUNCIL TO THE FACULTY SENATE -
Rpt No. 1985-86-6

c. Addition of a Non-thesis Option in Natural Resources Master of Science Program

Program requirements: Thesis option: A thesis and 24 credits of coursework including NRS 500. Non-thesis option: (with permission of department) 32 credits of coursework with a minimum of 14 credits in NRS to include NRS 500, 568 and 591, 3 credits in statistics, and a written masters examination. NRS 591 will require a substantial paper involving significant independent research.

C. College of Business Administration
1. Department of Management Science
a. Change

MGS 620 Quantitative Methods for Management - credits changed to-

MGS 620 Quantitative Methods for Management I and II, 2 or 3

UNIVERSITY OF RHODE ISLAND
The Graduate School

CURRICULAR REPORT FROM THE GRADUATE COUNCIL TO THE FACULTY SENATE -
Report No. 1985-86-6A

At its Meeting No. 250 on April 18, 1986, the Graduate Council unanimously approved the following proposal to replace the existing M.S. program in Industrial Engineering with a new M.S. program in Manufacturing Engineering, and to add and delete certain related courses. The new program, the contingent deletion of the existing program, and the course additions and deletions are now submitted to the Faculty Senate for approval.

Please note statement 11 on page 21, and the appended letter from J. Vernon Wyman, Assistant to the Vice President for Business Affairs, indicating that no new or additional resources will be required to implement the proposed new program.

This proposal has been prepared following the guidelines for abbreviated presentation set forth by the Rhode Island Board of Governors for Higher Education in their "Policy and Procedures for the Review of Instructional Program Developments and Organizational Changes in Rhode Island Public Institutions of Higher Education," July, 1984.

Please note that some pages of the abbreviated presentation have been deleted to save space on this Agenda. Full copies are available in the offices of the Faculty Senate, the Graduate School, the College of Engineering and the Department of Industrial and Manufacturing Engineering.

A. PROGRAM INFORMATION

1. Name of Institution:

The University of Rhode Island

2. Department, division, school or college involved:

Department of Industrial and Manufacturing Engineering,
College of Engineering

3. Title of proposed program and name of degree or certificate to be conferred:

Manufacturing Engineering,
Master of Science Degree

4. Areas of concentration and specialization:

The program will concentrate on the fundamentals of manufacturing processes, manufacturing automation, product design for efficient manufacture and the organization of manufacturing systems.

5. HEGIS title and classification code:

To be assigned upon proposal approval

6. Intended date of program initiation:

September 1986

7. Anticipated date for granting first degrees or certificates:

August 1987

8. Intended location of program:

Kingston Campus

9. Description of institutional review and approval process.

Department of Industrial and Manufacturing Engineering
College of Engineering Graduate Affairs Committee
College of Engineering Faculty

Graduate Council
Faculty Senate

10. Summary description of the proposed program:

The proposed graduate teaching and research program will be dedicated to building modern product design for manufacture and automation techniques, based on state-of-the-art computer technology, and geared to a firm understanding of manufacturing process capabilities.

The key elements of the program will be a strengthening of the ties between manufacturing engineering and product design and the development of methods of design for efficient manufacture. The core educational aims of the program will be to create an understanding of modern manufacturing systems coupled with the realization that manufacturing cost is determined to a major degree by the product designer. The program will contain the consistent emphasis, that truly efficient manufacture can only be obtained through communication with the product designer on all aspects of manufacturing process capabilities and cost. To achieve these aims the program will contain required core courses in Manufacturing Automation and Design for Manufacture. Students will also take elective courses in each of three main areas of manufacturing engineering; namely Fundamentals of Manufacturing Processes, Control and Organization of Manufacturing Systems and Computer Systems in Manufacturing Engineering and Design.

Administration of the program will be carried out by a Manufacturing Engineering Graduate Program Committee, with faculty representation from the main cooperating departments: Industrial and Manufacturing Engineering, Mechanical Engineering, Chemical Engineering and Electrical Engineering. The Chairman of the Graduate Committee of the IME Department will also serve as Chairman of the Manufacturing Engineering Graduate Program Committee and will also be the program director.

The unique characteristics of the proposed program are based on the following main resources:

(a) The extensive experience and reputation of the URI robotics program and the strength of the current faculty associated with that program.

(b) The recent transfer of Drs. Boothroyd and Dewhurst from the University of Massachusetts and Dr. Knight from Oxford University. This has boosted the capabilities in manufacturing engineering. The major thrust of the program will be computer integrated automation linked to design for manufacturability concepts; topics which are central research interests of the new faculty members.

(c) Existing faculty expertise in the Industrial and Manufacturing Engineering Department which will enable key courses to be offered in the control and organization of manufacturing systems.

(d) The existing laboratory facilities in processes, robotics and computer graphics which have been enhanced by the new Chester H. Kirk Applied Engineering Laboratory will give the students a unique opportunity to work in a "hands-on" environment in modern manufacturing processes.

IBM Corporation concluded from a recent survey of universities throughout the U.S., that the URI College of Engineering is the only engineering school in the country with the resources and faculty expertise in the key areas of design for manufacture and automation. Resulting from this assessment, IBM made a grant of $494,000 to help with the development of the proposed program. This grant will be spread over three years and will assist the proposed program with administration costs, release time for current faculty and the establishment of two new faculty positions. These resources will be used to expand and strengthen the program. The immediate proposal is to establish the new program as a replacement to the existing M.S. program in Industrial Engineering without the need for additional resources. This will provide an excellent basis from which to build the leading advanced-level program in manufacturing engineering in the country.

11. Statement indicating that no new or additional resources will be required to implement proposed new program:

The new M.S. program will be offered by the Department of Industrial and Manufacturing Engineering. However manufacturing engineering is essentially multidisciplinary and the program will take advantage of existing relevant graduate courses in the Departments of Mechanical, Chemical and Electrical Engineering.

The overall changes which will take place without the need for additional resources will be:

(I) Discontinue the present M.S. program in Industrial Engineering.

(II) Initiate a new M.S. program in Manufacturing Engineering for which there is a clearly expressed State and National need.

Immediate changes for graduate course teaching in the Department of Industrial and Manufacturing Engineering will be:

(a) Offer the following new graduate courses.

(i) Assembly and Handling Automation
(ii) Product Design for Manufacturability
(iii) Manufacturing Systems: Design, Analysis and Simulation
(iv) Metal Deformation Processes

(b) Delete the following existing graduate courses in Industrial Engineering which are not required for the new program.

(i) IME 510 Human Factors
(ii) IME 520 Material Handling

It should also be noted that the following graduate courses have already been discontinued as of the present academic year:

(i) IME 570 Operations research modelling in health care
(ii) IME 551 Advanced topics in probabilistic operations research
(iii) IME 657 Geometric and dynamic programming

The recent appointment of the three new faculty (Drs. Boothroyd, Dewhurst and Knight) in Industrial and Manufacturing Engineering provides sufficient resources in the department to teach existing graduate courses and offer the new ones listed under (a) above.

Following initiation of the program the grant of $494,000 from IBM will provide the resources to strengthen and expand the program over a period of three years. The grant will provide administration costs for the program expansion phase, and release time for selected faculty in Industrial and Manufacturing, Mechanical, Chemical and Electrical Engineering Departments to develop new courses relevant to the manufacturing engineering program. Searches will also be initiated for two new faculty with research and teaching experience in manufacturing engineering related areas. Utilization of the IBM grant money can proceed in this manner as soon as an assurance of State and University acceptance of the proposed new program can be obtained.

A successful graduate program in engineering must be based on a sound research program and the resources to attract good graduate students through the hiring of research assistants. Since its formation from the previous Industrial Engineering Department in July 1985, the new Department of Industrial and Manufacturing Engineering is already building a sound base of Federal and Industry research funding. Grants which have been obtained since July 1985 and research proposals which have been

submitted are listed below.

Existing Research Grants:

N.S.F. $100,000 for one year - "Economic Applications of Robots in Assembly"

I.B.M. $150,000 for three years plus two IBM robots - "Product design for robot assembly and the development of a two-arm single-station robot assembly system"

A.T.&T. $100,000 for one year - "Robot Assembly of Electronic Components" (with Mechanical Engineering Department)

C.D.C. $10,000 - "Design for Assembly of printed Circuit Boards"

Prime Computer, Inc. - Graphics Computer Workstation and Medusa solid modelling computer-aided design system

Research Proposals Submitted:

Allied Corporation $100,000 - "Product Design for Economic Manufacture"

IBM Corporation $434,000 for three years - "Database development for printed circuit board assembly work"

N.S.F. $189,000 for two years - "Programmable Automation and Design for Manufacture Economic Analysis"

A detailed description of the resources which are available to offer the new program is presented in an appendix to this proposal.

12. Signature of President:

Dr. Edward D. Eddy

13. Persons to be contacted during review:

Dr. M. Beverly Swan, Office of the Vice-President of Academic Affairs (792-5911)

14. Library Holdings

The Library at URI already has fairly substantial holdings in the area of manufacturing engineering. It is expected that the annual new acquisitions budget of the Department of Industrial and Manufacturing Engineering, together with some supplementation from the IBM grant if necessary, will enable a very strong library support base to be established within the grant period of three years.

The graduate courses which will be offered by the Mechanical, Electrical and Chemical Engineering Departments as elective courses for the proposed new program, represent existing teaching and research strengths. Thus for these courses no additional library support will be required.

The present library holdings for the Department of Industrial and Manufacturing Engineering contain approximately 2,600 texts of which over one-half fall into areas which are directly relevant to the proposed new graduate program. These areas are: operations research, materials processing, manufacturing facilities design, methods engineering, human factors in design, industrial safety and engineering economics. In particular the proposed minor concentration in Manufacturing Processes and Manufacturing Properties of Materials is reasonably well supported by over 300 texts in the materials processing category.

The University Library also subscribes to 39 periodicals and journals for the Department of Industrial and Manufacturing Engineering. Of this total, fourteen will provide support for graduate teaching and research in manufacturing processes, organization, control and simulation of manufacturing systems, operations research and quality assurance. To prepare for the initiation of the new program, the Graduate Committee of the Department of Industrial and Manufacturing Engineering will undertake a critical review of periodical and journal usage. It is likely that the Library will be requested to discontinute several journal subscriptions in order to enable journals in the area of computer-aided manufacturing to be obtained.

15. Laboratory Space and Facilities

The Department of Industrial and Manufacturing Engineering has adequate basic laboratory facilities which include machining and machine tools, specimen preparation rooms, an experimental foundry, basic metrology and measurement science controlled environment rooms and a microcomputer laboratory. The total laboratory space for the Department is approximately 4,300 square feet.

Some of the equipment is rather out-dated and there is need for co-ordinate measuring equipment for the metrology laboratory and two or more computer numerically controlled (CNC) machine

tools for projects involving flexible manufacturing systems. DiscussionS are already underway with some key Rhode Island industries for equipment gifts in the metrology field. It is also the intention of the faculty of Industrial and Manufacturing Engineering to seek C.N.C. machine gifts from the Society of Manufacturing Engineers and from private industry. The authors of the proposal have confidence that requests for manufacturing equipment gifts will be successful if the new M.S. program in manufacturing engineering is established. The gift of the CAD workstation, which will be received shortly from Prime Computer, Inc., will form an essential part of a future CAD/CAM system involving C.N.C. machine tools.

16. Resources presently available in the University and the College of Engineering to initiate the proposed new program are listed below.

1. Faculty who will be involved in the proposed new program in the Department of Industrial and Manufacturing Engineering:

Name	Rank	Area of Speciality	Highest Degree
G. Boothroyd	Prof.	Design for Manufacture, Automation, Machining and Machine Tools	D.Sc.
P. Dewhurst	Prof.	Design for Manufacture, Automation, Metal Deformation Processing	Ph.D.
W.D. Lawing	Assoc. Prof.	Applied Statistics and Experimental Design	Ph.D.
E. Nichols	Prof.	Quality Assurance and Engineering Economy	Ph.D.
C. Reynolds	Visit. Assoc. Prof.	Computer-Aided Manufacturing, Mechanics of Forging Processes	Ph.D.
W. Knight	Prof.	Computer-Aided Manufacturing, Group Technology Systems	Ph.D.
D.M. Shao	Assoc. Prof.	Operations Research and Simulation of Manufacturing Systems	Ph.D.
J.G. Sylvia	Visit. Assoc. Prof.	Casting and Solidification Processes and the Mechanics of Abrasive Water-Jet Cutting	M.Ed.

2. Faculty in related disciplines whose research and teaching interests are supportive of the proposed program:

(i) Department of Mechanical Engineering

Name	Rank	Area of Specialty	Highest Degree
P. Datseris	Assoc. Prof.	Expert Systems in Design and Manufacture, Mechanical Design	Ph.D.
T.J. Kim	Prof.	Materials in Manufacture, Mechanics of Machining and Cutting Processes	Ph.D.
W.J. Palm	Assoc. Prof.	Mechanics of Robot Manipulators and Mechanical Design	Ph.D.

(ii) Department of Chemical Engineering

Name	Rank	Area of Speciality	Highest Degree
S. Barnett	Prof.	Processing and Properties of Polymers	Ph.D.
R. Brown	Assoc. Prof.	Properties of Metals and Alloys and Metal Casting Processes	Ph.D.

(iii) Department of Electrical Engineering

Name	Rank	Area of Speciality	Highest Degree
F. Cohen	Assoc. Prof.	Computer vision and pattern recognition	Ph.D.
R. Vaccaro	Asst. Prof.	Digital control theory	Ph.D.

3. Graduate Courses Available to Support the new degree program:

(i) Department of Industrial and Manufacturing Engineering

IME 542	Computer-Aided Manufacturing
IME 544*	Assembly and Handling Automation
IME 549*	Product Design for Manufacturability
IME 540	Production Control and Inventory Systems
IME 513	Statistical Quality Assurance
IME 545**	Manufacturing Systems: Design Analysis and Simulation

IME 546** Metal Deformation Processes
IME 500 Network Application in Industrial Engineering
IME 533 Advanced Statistical Methods for Research and Industry
IME 525 Simulation

* To be offered from Spring Semester 1987
**To be offered from Fall Semester 1986

(ii) Department of Mechanical Engineering

MCE 521 Reliability Analysis and Prediction
MCE 566 The Mechanics of Robot Manipulators
MCE 430* Computer-Aided Design
MCE 431* Computer Control of Mechanical Systems
MCE 505 Optimization in Mechanical Engineering Design

*Suitable electives for graduate students with Industrial Engineering B.S. degrees

(iii) Department of Electrical Engineering

ELE 583 Computer Vision
ELE 581 Artificial Intelligence
ELE 584 Pattern Recognition
ELE 545 Design of Digital Circuits

(iv) Department of Chemical Engineering

CHE 533 Engineering Metallurgy
CHE 573 Mechanical Metallurgy
CHE 532 Ceramic Engineering
CHE 530 Polymer Chemistry
CHE 531 Polymer Engineering

(v) College of Business Administration

MKT 601 Managerial Marketing
FIN 601 Financial Management
ACC 610 Financial Accounting
MGT 630 Organizational Theory and Behavior
LRS 542 Labor Relations and Collective Bargaining

In order to take any of the courses listed above, students will of course be required to satisfy any course prerequisites.

PROPOSED MASTER OF SCIENCE DEGREE
in
MANUFACTURING ENGINEERING

Graduate School Bulletin - Sample Entry

Master of Science in Advanced Manufacturing Engineering

Admission requirements: GRE and B.S. degree in Industrial, Manufacturing or Mechanical Engineering. An applicant with a B.S. degree in another field of engineering, mathematics, physics, chemistry or computer science will be considered; such applicants will be required to complete some deficiency courses.

Program requirements:

1. Six credit thesis

2. Required Core Courses (nine credits)
   IME 544* Assembly and Handling Automation
   IME 549* Product Design for Manufacturability
   IME 542 Computer-Aided Manufacturing

3. Required Elective Courses (nine or more credits)
   At least one course must be taken from each of the three subgroups below:

   (i) Fundamentals of Manufacturing Processes and Manufacturing Properties of Materials

   IME 546 Metal Deformation Processes
   IME 541 Materials Processing and Metrology II
   CHE 531 Polymer Engineering
   CHE 532 Ceramic Engineering
   CHE 533 Engineering Metallurgy

   (ii) Control and Organization of Manufacturing Systems

   IME 545 Manufacturing Systems: Design, Analysis and Simulation
   IME 540 Production Control and Inventory Systems
   IME 513 Statistical Quality Assurance
   IME 514 Special Topics in Statistical Quality Assurance
   MCE 521 Reliability Analysis and Prediction
   IME 634 Design and Analysis of Industrial Experiments

(iii) Computer Systems in Manufacturing Engineering and Design

ELE 583 Computer Vision
ELE 581 Artificial Intelligence
MCE 566 The Mechanics of Robot Manipulators
MCE 506 Introduction to Expert Systems for Design and Manufacturing
IME 525 Simulation

4. Additional Elective courses
The remaining graduate courses to meet the required total of 24 coursework credits, will be selected with the advice of the student's major professor.

5. Manufacturing Processes Experience
Students following the program who have no previous experience with manufacturing processes and equipment will take IME 440, Materials Processing and Metrology I, as an additional course requirement.

*URI B.S. graduates in Industrial Engineering who have taken IME 444 and IME 449 in their senior year cannot take IME 544 and IME 549 for graduate credit. For these graduate students the required core courses will be:

IME 542 Computer-Aided Manufacturing
IME 591 (or IME 592)
Automation and Design for Manufacture Project
(3 credit project with individual faculty supervision)
Elective graduate course

College of Engineering
Department of Industrial and Manufacturing Engineering

1. Course Changes

IME 513 Statistical Quality Control - title changed to:

IME 513 Statistical Quality Assurance

IME 514 Special Topics in S.Q.C. - title changed to:

IME 514 Special Topics in S.Q.A.

IME 545 Manufacturing Engineering: Design, Analysis, Synthesis - title, description, prerequisite changed to read:

IME 545 Manufacturing Systems: Analysis, Design, Simulation I,3
Problems in manufacturing system analysis and design. Quantitative models and simulation methods applied to production planning, control, scheduling, resource allocation, and decision making in various types of manufacturing systems. (Lec 3) Pre: IME 433 or permission of instructor. Shao

2. Add (New)

IME 544 Automatic Assembly II,3
Types and economics of automatic assembly systems. Analysis of automatic feeding and orienting techniques for small parts. Application of robots in assembly. Economics of assembly systems for printed circuit boards. Note: Not available as graduate credit for students with IME 444. (Lec 3) Pre: IME 440 or permission of instructor. Boothroyd/Dewhurst

IME 546 Advanced Metal Deformation Processes I,3
Theory of metal flow under different loading conditions. Prediction of metal forming process capabilities. Advanced topics include effects of anisotrophy and mechanics of powder forming. Note: Not available as graduate credit for students with IME 446. (Lec 3) Pre: IME 440 or permission of instructor. Dewhurst

IME 549 Advanced Product Design for Manufacturability II,3
Methods for analyzing the efficiency of manufacture of new product designs. A design project and term paper are required. Note: Not available for graduate credit for students with IME 449. Pre: IME 440 or permission of instructor. Dewhurst/Boothroyd

3. Deletions

IME 510 Human Factors
IME 520 Materials Handling

University of Rhode Island, Kingston, R.I. 02881
Office of the Vice President for Business and Finance

May 5, 1986

(SECOND SUBMISSION)

To: Sheila Grubman

From: J. Vernon Wyman

Subject: RESOURCE REQUIREMENT AND BUDGETARY IMPACT REVIEW FOR THE PROPOSED MASTER OF SCIENCE DEGREE IN ADVANCED MANUFACTURING ENGINEERING

I have reviewed the documentation provided by the College of Engineering, regarding the proposed M.S. in Advanced Manufacturing Engineering with consideration for budgetary and other resource requirements.

The College of Engineering has made considerable investments in the development and enhancement of expertise in industrial and manufacturing engineering, particularly with the recent appointment of Drs. Boothroyd, Dewhurst, and Knight. It is evident that a critical mass of distinguished faculty, research grants and external support, facilities, equipment, and library resources has been assembled with the potential of providing strong support to a new masters program in advanced manufacturing engineering.

The proposal comes forward from the College of Engineering with a statement that no new or additional resources will be required to implement the proposed new program. Several factors are cited in support of this statement:

- The present M.S. program in Industrial Engineering would be discontinued with the implementation of the proposed program.

- A $494,000 three-year grant from IBM Corporation is available to address program development costs. Specifically the grant would support administration costs for the early expansion phase of the program, release time for faculty in related engineering departments to work on course development, support for two new faculty positions, and possibly supplemental support for library acquisitions.

- The sponsored research base has been expanding with $360,000 in current research funding from federal and corporate sources and over $600,000 in submitted grant proposals.

- Prime Computer, Inc. has provided a gift to the University of a graphics computer workstation and a Medusa solid modelling computer-aided design system which will have direct applications in the proposed program.

- Library holdings in the manufacturing engineering area are substantial and the combination of funding support from the Library, engineering departmental budgets, and, as necessary, the IBM grant suggests that good library resources will be available for the proposed program.

- Laboratory facilities, including the new Kirk Applied Engineering Laboratory, are available and equipped to support the program. It is indicated that equipment needed in support of the metrology laboratory and flexible manufacturing systems projects are being sought through proposals for private gifts. Optimism is expressed regarding the success of these proposals.

The College of Engineering indicates that the new program in manufacturing engineering would be proposed at this time with or without the IBM grant. The investment by IBM will clearly enhance the development phase of the program, but it is supplemental to the resources currently available to the College of Engineering for the suppport of the program. The grant provides funding for two new faculty members for the early phase of the program. The two faculty positions, however, are not required for the implementation of the M.S. program in Manufacturing Engineering. This budgetary impact review does not address the continuation of these positions beyond the availability of non general funding. Should a decision be made to continue these positions, consideration for the availability of position slots and salary and fringe benefit funding would be required.

I was unable to reference anticipated enrollments for the M.S. in Advanced Manufacturing Engineering relative to enrollments in the M.S. in Industrial Engineering. With the objective of achieving national accreditation and the evident demand for knowledge in this field, the outlook for students in the program would appear to be favorable with only one other acredited masters level program in the nation at the University of Massachusetts.

The Rhode Island economic development links would be benefited through the provisions cited for attendance by graduate professional level engineers from area firms on a part-time basis. The research activities associated with the program and the program graduates themselves also provide potentially important resources for area industries.

JVW/io

cc: William Ferrante
Beverly Swan
Hermann Viets