S03-09

A PROPOSAL FOR THE CREATION OF A MASTER OF SCIENCE IN ENTERPRISE COMPUTING

1. Name of Department Originating the Proposal:
   Interdepartmental Program between the College of Engineering and College of Business including:
   Department of Industrial and Manufacturing Systems Engineering
   Department of Logistics, Operations, and Management Information Systems
   Department of Electrical and Computer Engineering

2. Name of Degree:
   Master of Science with a major in Enterprise Computing

3. Name of Department which Administers the Program:
   This degree is offered and administered as an Interdepartmental Program under the guidelines of a separate governance document. The program reports to the Graduate College

4. Rationale for the Degree:
   Enterprises are organizations that produce and distribute goods or services. Enterprise computing is an emerging field that addresses the information gap between business and engineering. For example, business plans may be formulated for a company without considering the impact on production and other engineering related areas. A new curriculum is proposed to prepare professionals who can bridge this gap and successfully develop and implement integrated, network-based information technology solutions for modern enterprises. The major technical challenges of implementing such enterprise computing solutions are currently poorly understood by the typical engineering graduate. This can be attributed in part to the lack of adequate preparation for the technical problems that engineering students will encounter when they graduate. While elements of the necessary background can be found in different degree programs (both within and outside engineering), an integrated approach to enterprise computing is not available.

   In February of 1999, the Directorate for Engineering at the National Science Foundation issued a memorandum on the subject of *Scalable Enterprise Systems* and invited the research community for input. According to the memo, one of the highest growth sectors of the commercial software market has been ERP (enterprise resource planning) systems. Companies specializing in this sector of the market have enjoyed annual growth rates of 50% or more and have become the jewels of Wall Street. The memo describes enterprise-wide automation as a promising new area of research and, consequently, academic participation and training. In addition, it stated that a science-base to underpin the entire field of enterprise-wide software automation is needed now, and that the manufacturing community should take the lead. The special mention of the manufacturing community

stems from the fact that this community has traditionally been in the forefront of systems automation and can draw from its experiences to build enterprise-wide automation solution.

In April of 1999, again the Directorate for Engineering at the National Science Foundation convened a two-day panel of forty individuals to discuss and advise the agency on how to stimulate research on enterprise-wide automation that will meet the requirements of commerce in the 21st century. Membership in the panel was drawn from academia, industry and government. As always, the interest of NSF in research in enterprise-wide automation is intertwined with its educational mission. Thus, in convening the panel, the agency was simultaneously seeking ways to stimulate education and training in the area. Providing the environment for research and education is clearly where academia fits in the three-way partnership between academia, industry and government (a partnership the panel deemed necessary for future development of enterprise-wide automation).

A recent study by the Department of Commerce, *America's New Deficit: The Shortage of Information Technology Workers*, focused on the need for new professionals and the need for new skill sets. They found that systems analysts "must not only have an understanding of information technologies, but also business, scientific, manufacturing, or engineering problems."

The discussions at the panel indicated that research and education in the area are needed and that it is the responsibility of universities to devise the mode or instruments to produce graduates that have skills in designing and developing enterprise-wide automation solutions. Providing a solid background in this area is the primary motivation behind the new M.S. degree in Enterprise Computing.

5. Objectives

The objective of this program is to prepare students for the design, analysis, and implementation of scalable enterprise systems. The program addresses the gap between engineering and business information infrastructures. The intent of this new M.S. degree is to provide professionals with advanced studies in enterprise computing and information engineering. The program is intended for students interested in a terminal degree in this field, hence the creative component. Given the nature of the courses and the structure of the program, this degree is ideally suited for distance education as well as traditional environments.

It is expected that students would be employed in positions such as enterprise system architect, programmer/analyst e-commerce, lead engineer, data mining engineer, data integration engineer, supply chain specialist, e-Procurement content specialist, or information architect.

Learning Outcomes

The learning outcomes for the M.S. degree are as follows.

Comprehension

1) Graduates will understand the concepts and principles of information processes in an enterprise.
2) Graduates will understand the concepts and principles of information engineering methods.
3) Graduates will understand the capabilities and limitations of information technology.

Application

1) Graduates will be able to successfully use information engineering methods to achieve enterprise objectives.
2) Graduates will be able to implement enterprise computing systems using appropriate information technology.
3) Graduates will be able to develop prototype systems for feasibility and conceptual designs.

Analysis

1) Graduates will be able to analyze and evaluate information technology solutions.
2) Graduates will be able to analyze and assess functional requirements and needs for large scale integrated enterprise computing systems.
3) Graduates will be able to test enterprise computing systems to determine performance metrics.

Synthesis

1) Graduates will be able to design elements for the information infrastructure.
2) Graduates will be able to design enterprise computing architectures for a set of functional requirements.
3) Graduates will be able to design test plans for evaluating enterprise computing systems.

Assessments

Student assessment for these learning outcomes will include both formative and summative assessments.

Formative Assessment

The domain knowledge of students in graduate courses will be assessed using examinations, assignments, and group projects. The results of these assessments will be used to improve student performance in the learning outcomes.

Summative Assessment

A creative component and final examination will be used to assess individual achievement in terms of an integrated representation of student knowledge. This assessment will focus on knowledge acquired by students and their cognitive processes (in the context of open-ended problems).

6. <u>General Description:</u>

This program provides advanced studies in the principles and practices of information engineering for enterprise-wide systems. Course work includes a core set of courses supplemented by electives selected from specified lists of possible courses. The creative component provides an opportunity for students to demonstrate their ability to integrate their education in addressing a problem of current interest in the field.

7. Comparison with other programs:

a. This program is the first program of its kind at a national land grant institution. There are no similar programs within the Regents institutions or other higher education institutions within the state of Iowa.

b. There are no external accreditation requisites for this type of program.

Carnegie Mellon University has a graduate program with a Master of Science in Electronic Commerce which has some similarities with our program. The emphasis of their program is evenly divided between business and technology.

8. Program Requirements:

a. Prerequisites

Students must have graduated from an accredited undergraduate engineering, science, or information systems program. Other majors will be reviewed on an individual basis.

b. Language requirements

There are no language requirements.

c. Courses

The requirements for the M.S. is 30 credits of course work including a creative component.

Required Core Courses

		Credits
IE 581	E-Commerce Systems Engineering	3
IE 582X	Enterprise Modeling and Integration	3
MIS 533	Data Management for Decision Makers	3
MIS 535	Telecommunications/Computer Networking	3
		12 credits

Electives

Select five electives from the following lists with at least two electives from each category.

Enterprise Computing

MIS 534 Strategic Planning for E-commerce
MIS 538 Business Processes and Systems Development

IE 588 Information Systems for Manufacturing
POM 522 Manufacturing Information Systems

Information Engineering
IE 583 Knowledge Discovery and Data Mining
MIS 537 Information Resource Management
MIS 531 Business Software Development
Cpr E 530 Advanced Computer Networking
Cpr E 485 JAVA and Internet programming
Cpr E 531 Information Systems Security

15 credits

Creative Component 3 credits

Total 30 credits

d. New courses

All required courses are currently being taught.

e. Thesis and Non-Thesis Options

The only option for this program is the Non-Thesis Option as described earlier.

Standing Graduate Committee

To reduce the work load on participating faculty, a standing committee of three graduate faculty members will be appointed each year by the Director of Graduate Studies for the program. The standing committee members will serve as committee members for each student graduating in that year. The standing committee will be responsible for the final exam.

f. Implications for related areas

This program will provide a point of mutual collaboration between faculty in the department of Industrial and Manufacturing Systems Engineering, LOMIS, and Computer Engineering. It is expected that the synergy of these departments will enhance the capabilities of Iowa State University to address educational needs in the information technology area.

g. Admission standards

The typical student admitted to the program will have the following characteristics.

1. Top quartile in an accredited undergraduate engineering, science, or business program (with grade point approximately 3.00 or better). Other majors will be reviewed on an individual basis.
2. GRE (Q) 700 or better (approximately 80 percentile)
   GRE (A) 4.5 or better (approximately 70 percentile)
   GRE (V) 520 or better (approximately 60 percentile)

   OR

GMAT 630 or better (approximately 80 percentile)

3. TOEFL 230 for international students from non-English language countries.

9. General Description of Resources

a. Current Participating Faculty

John Jackman (IMSE)
Sigurdur Olafsson (IMSE)
Frank Peters (IMSE)
Sarah Ryan (IMSE)
Jo Min (IMSE)
Anthony Hendrickson (LOMIS)
G. Premkumar (LOMIS)
Anthony Townsend (LOMIS)
Doug Jacobson (CprE)

b. Effects of the new work load

By using the standing graduate committee described earlier, the work load of serving on graduate committees will be less than individual committees.

There is sufficient capacity in the existing course offerings to accommodate the additional students.

Courses required by this program are currently being offered by the participating departments. The Department of Industrial and Manufacturing Systems Engineering will reallocate some of the administrative duties of their support staff to support the program.

c. Research facilities

The departments have established laboratories to support this program. These laboratories include an Enterprise Computing Laboratory with 12 client workstations and server stations. The laboratory has development tools for enterprise-wide systems. The Scalable Enterprise Laboratory currently supports research activities funded by the National Science Foundation.

d. Library facilities

No additional library resources are necessary.

e. Other

No additional resources are necessary.

10. Relationship to strategic plans

This program is a major element of the IMSE department's strategic plan in the area of enterprise computing. It is also consistent with the LOMIS department's

strategic plan. Graduates of this program will have the advanced knowledge to engineer complex enterprise-wide computing systems. This field of study is receiving increased emphasis in the field of industrial engineering.

This program is consistent with the College of Engineering and College of Business strategic plans and the university's strategic plan. The goal of this program is to increase graduate enrollment with a focus on U.S. students. This program will produce professionals that can help Iowa industries with their information engineering needs.

11. Letters of support

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Industrial & Manufacturing
Systems Engineering
2019 Black

Interoffice Communication

(515) 294-1682
(515) 294-3524 (FAX)

DATE: **February 6, 2002**

TO: **Ken Kruempel, Chair**
Faculty Senate Curriculum Committee

FROM: **PE Patterson**
Chair

RE: **Support for Enterprise Computing MS**

The faculty in the Department of Industrial and Manufacturing Systems Engineering strongly endorse the proposed interdepartmental M.S. in Enterprise Computing and Information Engineering. This program is an essential element of our strategic plan and will help support Iowa State University's strategic plan to strengthen information technology research and education opportunities.

This program provides a unique blend of coursework in management and technology that addresses the need for information technology solutions for complex engineering systems. It is expected that this program will lead to further collaborations between the three departments.

As part of this program, the department will be offer existing courses and develop new courses as needed. The department also maintains computing facilities to support research and education activities. The department has two facilities, the Enterprise Computing Laboratory and the Scalable Systems Laboratory, that are already being used to develop new methods and technologies for enterprise computing.

Currently there are six faculty members performing research and teaching in this area. As faculty positions become available in the department, future faculty will be recruited to support enterprise computing.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Business
Department of Logistics,
Operations, and Management
Information Systems
300 Carver Hall
Ames, Iowa 50011-2063
Phone: 515-294-2132
FAX: 515-294-2534

February 11, 2002

Dr. Ken Kruempel
Chair, Graduate Curriculum Committee
Iowa State University
1124 Coover Hall
Ames, IA 50011

Dear Dr. Kruempel:

The purpose of this letter is to convey the support of the Logistics, Operations, and Management Information Systems department in the College of Business for the proposed Masters of Science joint program in Enterprise Computing and Information Engineering. This will be a program administered and supported jointly between the Logistics, Operations, and Management Information Systems department in the College of Business and the Industrial and Manufacturing Systems Engineering department and Electrical and Computer Engineering department in the College of Engineering at Iowa State University. This program will provide students with a unique blend of business and engineering skills that will allow them to contribute significantly in an important and demanding area of information systems.

Enterprise Systems are extremely complex and require a high degree of integration of technical networking architecture skills and strong knowledge of interconnected business processes. This program will assist students in acquiring the skills that organizations need in this sophisticated information technology environment. Demand for these skills continues to grow as the market for this software matures with an increasing number of organizations implementing this type of holistic enterprise software solution. Additionally, demand is spurred by the number of existing installations that require significant skill to operate, maintain, and enhance.

While our existing Masters of Science in Information Systems addresses some of the topics necessary for success in this area, its focus is broader and thus the curriculum does not allow students the opportunity to fully develop all the skills necessary without exceeding the degree requirements. The MIS faculty believe this program will augment well with the other graduate programs we support in information systems and that students in this curriculum will complement those in existing programs. As an additional note, this program will also foster closer ties between the departments and assist both faculty and students in more interdisciplinary research activities.

I hope you and your colleagues will support this important program initiative. If you have any further questions, please don't hesitate to contact me.

Sincerely,

Anthony R. Hendrickson

Anthony R. Hendrickson, Ph.D.
Chairman - Department of Logistics, Operations, and
Management Information Systems

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Liberal Arts and Scie
Department of Computer Scien
226 Atanasoff Hall
Ames, Iowa 50011-1041
515 294-4377
FAX 515 294-0258
Internet: www.cs.iastate.edu

Interdepartmental Memo

Date: September 15, 2003

To: Dr. Ken Kruempel, Chair
Faculty Senate Curriculum Committee

From: Carl K. Chang, Professor and Chair
Department of Computer Science

Carl K. Chang

Copy: John Jackman, Associate Professor, Department of Industrial and Manufacturing Systems Engineering
Anthony R. Hendrickson, Associate Dean, College of Business

Re: Endorsement for the Enterprise Computing degree proposal

The Department of Computer Science hereby endorses the proposal for the creation of a Master of Science degree in Enterprise Computing, with the following recommendations.

Our faculty would like to include the following four courses as "technical electives" for the new MS degree in Enterprise Computing.

ComS 554 Distributed and Network Operating Systems
ComS 561 Principles of Database Systems
ComS 562 Implementation of Database Systems
ComS 586 Computer Network Architectures

We believe that students in this new program will benefit tremendously from taking the suggested Computer Science courses to better prepare them for the profession.

THE UNIVERSITY OF IOWA

November 25, 2002

John Mayfield
Associate Dean, the Graduate College
Pearson Hall Room 10
Iowa State University
Ames, Iowa 50011

Dear Dean Mayfield:

Thank you for the opportunity to review the proposal for the creation of a new graduate degree program (Master's) in Enterprise Computing. The carefully assembled proposal is clear in its intent to orchestrate a timely interdisciplinary degree program across several collegiate/departmental boundaries.

I have shared this proposal with the Deans of the Colleges of Engineering and Business, respectively, who report that while there are probably some courses that have overlapping goals, there is no degree program here at the University of Iowa similar in nature to the proposed program.

Thank you once again for the opportunity to review the proposal. Best of luck with the approval process and implementation of this new graduate degree program.

Sincerely,

John C. Keller
Associate Provost for Graduate Education and
Dean, the Graduate College

The University of Northern Iowa

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COLLEGE

Nov. 25, 2002

Dr. John Mayfield,
Associate Dean
Graduate College
RM 10
2206 PEARSON
Ames, IA 50011-2206

Dear Dr. Mayfield:

The Department of Computer Science at the University of Northern Iowa has reviewed your proposal for creation of a Master of Science in Enterprise Computing at Iowa State University. We support your efforts to create this new graduate major and see no conflicts with our curricular offerings.

As noted in the proposal, the new major will be unique within the national land grant institutions and there are no similar programs within Iowa's institutions of higher learning. As a distinctive interface between the College of Engineering and the College of Business it seeks to meet practical needs for professional training in Iowa.

We are pleased to support your program proposal. If you have additional questions or concerns please contact me.

Sincerely,

Bart Bergquist

Bart Bergquist
Acting Head
Department of Computer Science
WRT 219
University of Northern Iowa
Cedar Falls, IA 50614
(319) 273-2618
bergquist@uni.edu

Regents Program Review Questions (Majors)

Master of Science Degree, Major in Enterprise Computing

1. Need
   a. How will this proposed program further the educational and curriculum needs of the students in this discipline?

      This program will provide students with a new field of advanced study in enterprise computing. Students are currently ill prepared for careers in developing enterprise-wide applications under current curricula available to the students. At the same time, industry has a major need for graduates with these capabilities.

   b. How does it further the educational and curriculum needs of other units in the college or university?
      Course work offered through this program provides students from other graduate programs with outside electives in new subject areas. It is expected that students from Industrial Engineering, Management Information Systems, Computer Engineering, and Computer Science would be most likely to benefit from the program.

2. Duplication and Collaboration
   a. What programs in this field of study are available in other colleges and universities in Iowa? (Identification of other programs available in this field at other institutions should be made within a broad definitional framework. For example, such identification should not be limited to programs bearing the same title, the same degree designation, having the same curriculum emphasis, or purporting to meet exactly the same needs as the proposed program.)

      There are no similar programs at other colleges and universities in Iowa. The most closely related study areas are Management Information Systems, Computer Science, and Computer Engineering at Iowa State University and Computer Science at the University of Iowa.

   b. With what representatives of these programs has there been consultation in developing this proposal? Provide a summary of the responses of each institution consulted. (The complete text of responses should be included.)

      The Industrial and Manufacturing Systems Engineering, Management Information Systems, and Computer Engineering at Iowa State University support the establishment of this program.

   c. In what ways is this proposed program similar to those mentioned in 2a? In what ways is it different or does it have a different emphasis? (In describing program similarities and differences, consider such factors as curriculum, prospective student groups to be served, and career or other types of goals to be emphasized.)

      This program emphasizes the engineering and systems aspects of large scale enterprise-wide systems. Information technology is a major element of this program due to its pervasive use in modern enterprises. In addition, the program provides students with engineering principles, methods, and problem solving techniques for enterprise processes.

   d. How does the proposed program supplement the current programs available? (In some instances, this question should go beyond how the program will supplement others within the state. If the justification for

the program involves special regional or national needs, a description of existing programs within the region or the nation and the relation of the proposed program to these should be provided.)

Our program can provide a systems perspective for the related programs as well as showing the relationship of information technology to other enterprise processes.

e. Has the possibility of some kind of interinstitutional program or other cooperative effort been explored? What are the results of this study? (Consider not only the possibility of a formally established interinstitutional program, but also how special resources at other institutions might be used on a cooperative basis in implementing the proposed program solely at this institution.)

No cooperative effort has been explored.

f. Please list the Iowa institutions in which articulation agreements are being developed for the proposed program. (NOTE: This applies only to community college degree programs that may transfer students to this program.)

There are no agreements.

g. Please provide the Classification of Instructional Program (CIP) code for the proposed program. (The code may be obtained from the statistics area of the Office of the Registrar (4-4150) or look at the following web site: http://www.ncsu.edu/provost/academic_affairs/cc/cip_proj/cip_manu.htm)

11.0401 Information Sciences and Systems

3. Please estimate the enrollment in this program for the next five years as follows:

a. Undergraduate

Majors					
Non-Majors					

b. Graduate

Majors	10	20	30	30	30
Non-Majors	3	3	5	5	5

1. On what basis were these estimates made?

Based on current enrollment in our enterprise computing courses we would conservatively expect 10-15 students entering this program initially on an annual basis.

2. What are the anticipated sources of these students?

(For example, persons currently enrolled in other programs within the institution; persons currently attending other institutions, in state or out of state; persons not currently enrolled in institutions of higher education.)

Persons currently enrolled in other programs within the institution; persons currently attending other institutions, in-state or out-of-state; persons not currently enrolled in institutions of higher education.

4. Please provide any available data or information on employment opportunities available to graduates of this program in Iowa and nationally. (Such information is available from U.S. government labor sources as well as many professional associations.)

   It is projected that the need for systems analysts (a typical information technology career) will increase 92% by year 2005 (Source*: America's New Deficit: The Shortage of Information Technology Workers*, Department of Commerce).

5. Are there accreditation standards for this program?

   1. What is the accreditation organization?

      N/A

   2. What accreditation timetable is anticipated?

      N/A

   (Please provide a copy of the accreditation standards.)

6. Does the proposed program meet minimal national standards for the program, e.g., Council of Graduate Schools or other such bodies?

   This program meets the minimum standards of the Council of Graduate Schools.

7. Please report any reactions of the Iowa Coordinating Council for Post-High School Education. List date that the program information was submitted to the Council.

   None

8. How does this program relate to the college's/university's strategic plan?

   This program is consistent with the College of Engineering and College of Business strategic plans and the university's strategic plan to support programs in information technology. The goal of this program is to increase graduate enrollment with a focus on U.S. students. This program will produce professionals that can help Iowa industries with their information technology needs.

Additional Resource Needs

Either question one or question two requires a "yes" answer. In addition to a "yes" response to one of the first two questions, question three and question four should be answered. If applicable, question five should be answered.

1. Will the program require <u>new</u> resources? Yes ___ No __X__
   If "yes," what is the plan to obtain new resources?

2. Will the program require <u>reallocated</u> resources? Yes _X_ No ___
   If "yes," what is the university's reallocation plan to fund this program?

By using a standing graduate committee described earlier, the work load of serving on graduate committees will be less than individual committees.

As shown in the table below on course capacity, there is sufficient capacity to accommodate the additional students.

Courses required by this program are currently being offered by the participating departments. Given the expected number of students in the program, a major reallocation will not be necessary. The Department of Industrial and Manufacturing Systems Engineering will reallocate some of the administrative duties of their support staff to support the program.

3. At what level of enrollment will additional resources be required for the program?

   Additional resources would be required if enrollment exceeds 50 students.

4. Estimate the total costs (or *incremental increases in expenditures*) that may be necessary as a result of the new program for the next three years.

	First Year	Second Year	Third Year
a. Faculty	0	0	0
b. Graduate Assistants	0	0	0
c. General Expense	0	0	0
d. Equipment	0	0	0
e. Library Resources	0	0	0
f. New Space Needs (estimated amt. & cost of new and/or remodeled space)	0	0	0
g. Computer use	0	0	0
h. Other resources	0	0	0
TOTAL(S)	0	0	0

The IMSE department will provide the administrative support necessary to manage the graduate program using our existing administrative staff. The additional 30-40 students could be accommodated with the current system.

The utilization of course capacity is shown in the following table for the past year.

Course	Average No. of Students	Average Class Limit	% Utilization
IE 581	8.5	25.0	34.0
IE 582	13.0	30.0	43.3
IE 583	18.0	25.0	72.0
IE 588	8.0	25.0	32.0
MIS 533	18.5	40.0	46.3
MIS 535	18.0	30.0	60.0
MIS 534	20.0	30.0	66.7
MIS 538	11.5	35.0	32.9
POM 522	9.0	27.5	32.7
MIS 537	17.0	25.0	68.0
MIS 531	18.5	40.0	46.3
CPR E 530	13.5	677.3	2.0
CPR E 485	24.7	25.2	98.1
CPR E 531	23.6	523.0	4.5

Note that the large capacity courses offer a large number of distance education slots so the utilization is artificially low. It can be seen that there should be sufficient capacity in these courses. For the few courses having higher utilization, they can be offered via distance education or the capacity can be slightly increased to accommodate the students in the new program.

Given the current utilization of offered courses, there is sufficient capacity to support the program without additional resources. In addition to the Computer Engineering courses offered as distance education, we will offer the Industrial Engineering (IE) courses through distance education as well. The financial income from distance education through these offerings will help supplement current resources.

5. For programs planning to use external grants, what would be the effect of the grant termination?

N/A

New program proposals for programs that are currently offered at one or more Regent universities must also complete the Board of Regents questions on potential program duplication contained in §6.09 of the BOR Policy Manual.

This program is not offered at other Regents institutions.