FORM G
BOARD OF REGENTS, STATE OF IOWA PROPOSAL FOR PROGRAM/DEPARTMENT NAME CHANGE October 3, 2010

Institution: Iowa State University

Current Title of Department/Program: Operations Research

Proposed Title of Department/Program: Operations Analytics

Name of College: Engineering and Liberal Arts and Sciences

Current CIP Discipline Specialty Title: Operations Research

Current CIP Discipline Specialty Number (six digits): 14.3701

Proposed CIP Discipline Specialty Title: Operations Research

Proposed CIP Discipline Specialty Number (six digits): 14.3701

Level: B M X D FP

Degree Abbreviation (e.g., B.S., B.A., M.A.): MS

Approximate date to change name: Month June Year 2014

Contact person: (name, telephone, and e-mail) Prof. Janis Terpenny, 515-294-1287, terpenny@iastate.edu

1. Provide a brief description of the department/program.

The ISU M.S. in Operations Research jointly administered by IMSE (Engineering) and Statistics (LAS) is a degree program that has been in existence since 1986, but has not enrolled students for several years. It focuses on the development and application of complex mathematical and/or simulation models to solve problems involving operational systems. Its existing degree requirements include courses from the each of the areas of 1) simulation, 2) data analysis, 3) economic analysis, 4) optimization, and 5) probabilistic modeling.

(Other M.S. degrees are available from the administering departments. In particular, the M.S. in Industrial Engineering degree administered by IMSE can be earned by focusing coursework and thesis work in the area of Operations Research.)

2. Describe reasons (justification) for the proposed name change. Include information about the value of the name change to the department, program, the discipline, college, and/or the university.

The name "Operations Research" is somewhat antiquated and not generally recognizable by the public and prospective graduate students. The subject matter of the program is now widely recognized under the name "Analytics" and is associated with the effective use of modern computing and high-volume data across a broad spectrum of applications in technology, commerce, and science. A relevant professional society, the Institute for Operations Research and the Management Sciences (INFORMS) now publishes a practice-oriented magazine called Analytics, runs an annual Analytics conference aimed at business, and offers certification for "Analytics Professionals." This proposal aims to make the ISU program more visible and accessible to future core technical analysts. This renaming is consistent with current trends in both Engineering and Statistics, where more and more academic programs are adopting names including the word "Analytics." Replacing the word "Research" with "Analytics" will communicate the focus of this
program on preparation for professional practice.

Attached to this document are external letters indicating support for this modernization of the program name.

3. If this is a department name change, describe how the proposed name is consistent with the mission of the college.

NA

4. Will the proposed name change be consistent with other institutions? Identify other institutions that have the same or similar name to the proposed name.

The name change will be consistent with modern usage already in place at many good institutions. Here is a list of a few similar programs that have adopted names involving "Analytics."

1. Master of Science in Analytics, Northwestern University, McCormick School of Engineering,

   http://www.analytics.northwestern.edu/

2. Master of Science in Analytics, University of Chicago, Graham School of Continuing Liberal and Professional Studies,

   https://grahamschool.uchicago.edu/credit/master-science-analytics/index

3. Master of Science in Analytics, Texas A&M University, Department of Statistics,

   http://analytics.stat.tamu.edu/

4. Master of Science in Analytics, North Carolina State University, Institute for Advanced Analytics,

   http://analytics.ncsu.edu/?page_id=1799

5. Master of Science in Data Analytics Engineering, George Mason University, Volgenau School of Engineering,

   http://volgenau.gmu.edu/dae

6. Master of Science in Analytics, University of San Francisco, College of Arts and Sciences,

   http://www.usfca.edu/artsci/msan/faculty/

7. Master of Science in Business Analytics, University of Tennessee, Department of Statistics, Operations, and Management Science,

   http://bus.utk.edu/soms/analytics/index.htm#

8. Master of Science in Data Analytics, City University of New York, School of Professional Studies,

   http://sps.cuny.edu/programs/ms_dataanalytics
9. Master of Engineering--Concentration in Data Analytics, Cornell University, School of Operations Research & Information Engineering,

http://www.orie.cornell.edu/orie/academics/master/index.cfm

10. Master of Science in Statistics: Analytics Concentration, University of Illinois, Department of Statistics,

http://www.stat.illinois.edu/degrees/msanalytics.shtml

11. Master of Science in Applied Statistics and Data Analytics, Southern Methodist University, Department of Statistical Science,

http://www.smu.edu/Dedman/Academics/Departments/Statistics/AppliedMSProgram

12. Master of Science-Business Analytics Track, University of North Carolina, Department of Statistics and Operations Research,

http://stat-or.unc.edu/programs/instore/instorems

5. Is the proposed name consistent with association/accreditation designations?

NA

6. Describe program configuration changes that will result from the proposed name change, e.g., change in number of credit hours required, etc.

See attached description with a side by side comparison of the existing dormant program and the renamed program. We intend to reduce the number of credits required in the program from 34 to 33. The most dramatic addition to the program is the new 3 credit capstone course that will consist of a large-scale group project in analytics, potentially with an external partner.

7. Describe how current students will be affected by the proposed department/program name change.

There are no current students in the program Operations Research MS program.

8. What costs will be incurred by the proposed name change? Identify new resources that will be needed in connection with the proposed name change, e.g., facilities, faculty, funds, etc.

If the proposed name change is approved, some part of one Faculty member's appointment will need to be dedicated to promoting the program with industry and seeking project opportunities for a new course built around semester projects conducted in groups.
Appendix: Letters of Support for Proposed Name Change
Janis,
Great hearing from you.
I am happy that your Department is getting into analytics and I am supportive of the proposed name change.
We have researched analytics for over a decade and incorporated it into a number of courses. At this time, we are developing new programs explicitly addressing analytics. I hope that the developments at both campuses will lead to collaborative programmatic opportunities.
Andrew

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....  Andrew Kusiak
....  Professor and Chair
....  Department of Mechanical and Industrial Engineering
....  2139 Seamans Center
....  The University of Iowa
....  Iowa City, Iowa 52242 - 1527

....  Tel: 319-335-5934  Fax: 319-335-5669
....  Email: andrew-kusiak@uiowa.edu
....  http://www.engineering.uiowa.edu/~ankusiak/
March 23, 2014

Dear Dr. Terpenny,

Please consider my note as support for the curriculum adjustment and name change for the MS degree in Operations Analytics.

In industry today we are rich with data. It comes from customer sources – POS capture points, consumer sources – internet shopping patterns and consumer shelf feedback, and marketing feedback. The challenge is in transforming the massive amounts of data into information that can be used to make decisions that will impact the product design and product placement.

The term “operations research” has not been used in our company in many years. In fact, our Operations Research department was renamed to Consumer Insights and Understanding well over 5 years ago.

In addition, the data analytics requirements in our industry today are broader than just the market research functions. It is a critical aspect of our demand and inventory planning functions and our supply chain planning processes. Again in this space, data analysis, statistical confidence assessment and information building are analytic skill sets used for decision making.

The proposed revision of the MS program requirements is better suited for the needs of business today. The rename of the program to Operations Analytics is more reflective of what industry is looking for. In addition, it is significantly more appealing to the potential student as an application degree as opposed to one focused on strictly research.

If you have any questions or seek additional perspective, please let me know.

Sincerely,

Mary Beth Brown
Vice President Product Integrity and Supply Chain Technical Resources
Hallmark Cards, Incorporated
2501 McGee, PO Box 419580, MD 701
(816) 274-5058
March 21, 2014

Janis Terpenny, Chair  
Industrial and Manufacturing Systems Engineering  
3004 Black Engineering  
Iowa State University  
Ames, IA 50011  

&  
Ken Koehler, Chair  
Department of Statistics  
Snedecor Hall  
Iowa State University  
Ames, IA 50011-1210

Dear Dr. Terpenny and Dr. Koehler:

I am writing to offer my full endorsement for the name change of the existing joint MS degree in Operations Research to Operations Analytics. This is indeed a timely and important change.

Evermore, analytics is recognized in our company as critical to decisions that impact planning, marketing and sales, production, distribution, and more.

I am delighted to see Iowa State University embracing the needs of industry with programs such as this. The name change should help our company and others to recognize graduates of the program in our strategic hiring.

Sincerely,

[Signature]

Dr. Dean L. Bartles, FSME  
Vice President & General Manager  
Large Caliber Ammunition  
General Dynamics - Ordnance and Tactical Systems  
11399 16th Court North, Suite 200  
St. Petersburg, FL  33716
March 25, 2014

Prof. Janis Terpenny, Chair
Department of Industrial and Manufacturing Systems Engineering

Prof. Ken Koehler, Chair
Statistics Department

Dear Professors Terpenny and Koehler,

The purpose of this letter is to express my support of the proposal to change the name of the MS program in Operations Research to Operations Analytics.

Organizational competence in “analytics” is widely recognized as a strategic asset in the business and industrial world. In my opinion, the proposed name better reflects the relevance of your academic program to the needs and interests of the potential employers of your graduates.

Thank you very much for your consideration.

Sincerely,

[Signature]
Necip Doganaksoy, Ph.D.

Principal Statistician
Fellow of the ASA
Fellow of the ASQ
Elected Member of the ISI
March 24, 2014

Janis Terpenny, Chair
Industrial and Manufacturing Systems Engineering
3004 Black Engineering
Iowa State University
Ames, IA 50011

&

Ken Koehler, Chair
Department of Statistics
Snedecor Hall
Iowa State University
Ames, IA 50011-1210

Dear Dr. Terpenny and Dr. Koehler:

Please accept this letter as strong endorsement of the proposed and advocated name change of the existing joint MS degree in Operations Research to Operations Analytics. This is indeed a timely and important change.

At Ralph Lauren, Inc. — a $7+ Billion global life-style brand with operations around the world — the importance of Business & Operations Analytics cannot be overstated. Indeed, we have created Business Intelligence & Analytics department as part of our Global Supply Chain team. Additionally, increasing focus on the gathering, managing, and analysis of unstructured “Big Data” further emphasizes the corporate need for this type of educational background. Analytics is clearly recognized in our company as critical to decisions that impact planning, marketing and sales, production/sourcing, transportation, supply chain operations, distribution/allocation, store operations, and more.

I am delighted to see Iowa State University aligning with the needs of industry with programs such as this. The name change should help our company and others to recognize the skills of the graduates of this program in our strategic hiring.

Sincerely,

David G. Rush
Vice President – Supply Chain Integration
BS IE 1985
March 24, 2014

Department Chair
Department of Statistics
Iowa State University
Ames, IA, 50011

Dear Professor Koehler:

As an alumnus of Department of Statistics of Iowa State University and currently working in advanced analytics organizations, I fully support and endorse the initiative of the name changing of the MS program to include "Analytics" in the name. Analytics has a broader application than the traditional "Operation Research" program in the new era of data rich world. Many universities and research institutions are now offering "analytics" related MS program, for example the extremely successful "Advanced Analytics Program" in North Carolina State University.

Shortly after my final defense, I joined the Applied Statistics Lab under the "Software Science and Analytics" organization of General Electric Global Research Center and my title was "Statistical Leader." Now I am in the "Advanced Analytics Division" of SAS Institute as a Research Statistician. When looking back of my career development, analytics is indeed throughout my whole career.

With the development of both computing hardware and software capability, data science and analytics are starting to become the essential part of every sectors of business and government. The current wave of data and analytics revolution will have profound impact not only in the business world, but also in university level educations especially MS programs. In summary, the name and track changes of the current Operations Research M.S. degree at Iowa State University will keep the program up to date in the dynamic environment of data revolution.

Sincerely,

Ming Li
Advanced Analytics Division
SAS Institute
March 26, 2014

Dr. Stephen Vardeman  
Statistics Department  
2212 Snedecor Hall  
Iowa State University  
Ames, IA  50011-1210

Dear Dr. Vardeman,

In response to getting the “Operations Analytics” MS Program under way; Steelcase, Inc. is very much in favor of developing a more structured advanced analytics curriculum at Iowa State University. Specifically, the name change being proposed is an important immediate step. We have been recruiting in this space over the past few years and we see that supply is low and demand is high. We strongly suggest that the program is a two year program with a balance of statistics, machine learning, OR and econometrics all intermingled with computer science for “Big Data”.

Tim Rey, Director  
Advanced Analytics  
Steelcase, Inc.
Janis Terpenny, Ph.D.
Joseph Walkup Professor & Department Chair
Industrial and Manufacturing Systems Engineering

Ken Koehler, Ph.D.
Statistics Department Chair

Iowa State University
3004 Black Engineering Bldg.
Ames, IA 50011-2164

Dear Professors Terpenny and Koehler,

I would like to offer my support for the proposed name change for the existing MS program in Operations Research to the new name of MS in Operations Analytics. This proposal reflects changes in industry where we desire a new set of skills in core technical analytical specialists. We welcome this shift in training to strengthen the program in analytics content. We believe it will be beneficial for Rockwell Collins and improve the attractiveness to students to better prepare for careers in industry.

We look forward to the benefits both for our company and to graduates from Iowa State University.

Sincerely,

Wayne Flory
Vice President, Operations
Rockwell Collins, Inc.
March 21, 2014

Prof. Janis Terpenny, Chair & Prof. Ken Koehler  
Department of Industrial & Manufacturing Systems Engineering & Statistics Dept.  
Iowa State University  
3004 Black Engineering Bldg  
Ames, IA 50011-2164

Dear Prof. Terpenny & Prof. Koehler,

I am writing this letter in support of the Iowa State IMSE & Statistics department’s proposed petition for a name change of an existing joint “MS program in Operations Research” to “MS in Operations Analytics”. We are in support of the name change in order to reflect modern needs and emphases in analytics that are desired by the students and employers.

J.B. Hunt Transport, Inc., is one of the largest transportation logistics providers in North America. J.B. Hunt has a sizeable industrial engineering function and has a close relationship with the Industrial Engineering Department at Iowa State University.

We are very much in support of the name change of the MS program.

I would encourage you to contact me if you have any questions about our level of commitment.

Sincerely,

Eric Ervin  
VP of Engineering & Technology  
479-820-8154
March 24, 2014

Professor Janis Terpenny, Chair
Department of Industrial and Manufacturing Systems Engineering
&
Professor Ken Koehler, Chair
Department of Statistics
Iowa State University
Ames, IA 50011-2164

Dear Colleagues:

It is my pleasure to endorse your efforts to change the name of the Joint MS program in “Operations Research” to “Operations Analytics.”

In my opinion, the draft proposal highlights the analytics content consistent with the core expectations within our industry.

As this program strengthens in its content or as your needs change, we will be honored to provide any necessary feedback that enriches the student training process in this field.

Sincerely,

Muffasir Badshah
Associate Scientist R&D
Advanced Analytics Department
26 March 2014

Prof. Janis Terpenny, Chair, Industrial and Manufacturing Systems Engineering
Prof. Ken Koehler, Chair, Statistics

Re: MS in Operations Analytics

Professors Terpenny and Koehler,

It is my pleasure to support a request for the Iowa State Departments of Industrial and Manufacturing Systems Engineering and Statistics to change the name of the joint MS program in Operations Research to Operations Analytics. We understand this is the first step to strengthening the analytics content of the program. Processing and analyzing large data sets and making optimal decisions based on the results are becoming more important capabilities across functional areas of industrial companies, especially in the product and manufacturing engineering domains. The potential program will help address increasing industry needs for core technical analytical specialists. Please let me know if you have any additional questions.

Sincerely,

[Signature]

Robert A. Stevens

Cc: Professor Stephen B. Vardeman
Appendix: Support and Comments from ISU Units
To: Whom it Concerns

Subject: Additional Information Concerning Request for Name Change for ISU M.S. in Operations Research

Date: August 13, 2014

From: Stephen Vardeman, University Professor of Statistics and Industrial Engineering

As you consider the submitted request for modernization of the name of the ISU "Operations Research" M.S. program to the currently more recognizable and appropriate "Operations Analytics," you may find it helpful to know of the substantial external validation of the international caliber of existing ISU efforts in this area recently provided by the winning of the 2014 Prudsys AG Data Mining Cup by an ISU graduate student team. Some details of the accomplishment can be found here:

http://www.news.iastate.edu/news/2014/07/10/data-miners

Thank you. We look forward to vigorously promoting a modernized program and extending ISU's influence and contributions in the Analytics arena.
Dear ISU and Board of Regents Reviewing Bodies,

Please find attached endorsements for the IMSE/Stat proposal for a name change of the existing MS Program in "Operations Research" to "Operations Analytics." This is a modernization of the name of the program in line with what other institutions and professional societies are using. We include:

- External Letters of Support for the name change
- An e-mail from Gianfranco Ciardo Chair of ISU Computer Science in support of the name change
- A Letter from Qing Hu expressing the hope that the proposed name change will not be confused with the proposal for a much different less technical professional masters degree the Business College is developing

Regarding the last of these, we hope that it is clear from our documentation that the existing program is technically oriented and aimed at producing core analysts and (as the Hu memo indicates) is much different from what the proposal for a new program that Business is developing.

Sincerely,

[Signature]

Janis Terpenny, Department Chair and
Joseph Walkup Professor

Attachments
I have read the memo and I fully support the change of name to "Operation Analytics" for the program.

I also envision that students enrolled in this program will be taking the listed Computer Science classes, and in turn I welcome this as a positive step that can eventually promote further collaborations between our faculty and students and those of Statistics and IMSE.

Sincerely,

Gianfranco Ciardo
Professor and Chair
Department of Computer Science
Iowa State University
MAIL:  226 Atanasoff Hall  Ames, IA 50011  USA
URL:  http://www.cs.iastate.edu/~ciardo/
EMAIL:  ciardo@iastate.edu
PHONE:  515-294-4377
MEMORANDUM

April 8, 2014

To: Kenneth Koehler, Professor and Chair, Department of Statistics
Janis Terpeny, Professor and Chair, Department of Industrial and Manufacturing Systems Engineering

From: Qing Hu, Associate Dean for Graduate Programs and Research

Cc: Sree Nilakanta, Chair of Supply Chain and Management Information Systems
Gianfranco Ciardo, Chair of Computer Science

Subject: Proposal for Program Revision/Modernization - M.S. Degree in Operations Research

The faculty members in the Department of Supply Chain and Information Systems have reviewed the proposed program change for MS in Operations Research to be renamed and reoriented to MS in Operations Analytics, in order to modernize the curriculum to reflect recent advances in “big data” and “data analytics.” While understanding the needs for the proposed changes to the MSOR program, the SCIS faculty have raised some concerns in light of another “data analytics” master’s proposal – Master of Business Analytics – that is being developed jointly by the departments of SCIS, Statistics, IMSE, and Computer Science. The primary concern is that, even though the two proposed programs have different orientations (one focuses on operations analytics, the other focuses on business analytics) and different target student population (one targets more traditional graduate students, the other targets working professionals), the core curricula of both programs focus on “data analytics” and the governance bodies, especially the Board of Regents, may not be able to make a clear distinction if submitted separately, and thus approval of one proposal may adversely affect the approval of the other.

The College of Business, therefore, recommends that both MS in Operations Analytics and Master of Business Analytics proposals be presented together to the University Senate, the Provost Office, and the Board of Regents for Approval. The proposal for Master of Business Analytics is in its final stages and expected to clear the College of Business in the next couple of weeks. Therefore, this delay should not have any material effect on the proposed MS in Operations Analytics program. We appreciate your understanding and support.
Appendix: Details on Program Modernization
Plan for Program Revision/Modernization
Iowa State University M.S. Degree in Operations Research
For Proposed Name Change to M.S. Degree in Operations Analytics
May 2, 2014

Industrial and Manufacturing Systems Engineering Department
College of Engineering
Prof. Janis Terpenny, Chair
terpenny@iastate.edu

Statistics Department
College of Liberal Arts and Sciences
Prof. Kenneth Koehler, Chair
kkoehler@iastate.edu

Rationale
The ISU IMSE and Statistics Departments have jointly administered an Operations Research M.S. degree since 1986. That program has been dormant for a number of years and is in need of serious modernization. In IMSE, an option for an Operations Research emphasis in the Department’s regular M.S. program has been far more popular than the joint degree. In Statistics, other areas of application (like biology) have enjoyed more attention from students than ones related to commerce and engineering operations. But recent explosion of interest in "analytics" and the use of "big data" across many areas of human endeavor ranging from engineering to commerce to science has created an opportunity to revitalize and modernize the program and immediately give ISU a strong presence in the burgeoning field of technical graduate education for "big data analytics." The U.S. Bureau of Labor Statistics predicts a more than 20% increase in jobs in this area by 2020. A report from McKinsey & Company claims “by 2018, the United States alone could face a shortage of 140,000 to 190,000 people with deep analytical skills.” A recent ComputerWorld report1 noted that Northwestern University’s Master of Science in Analytics, at the Robert R. McCormick School of Engineering and Applied Sciences, “received 600 applications for 30 openings” in its entering class and the Master of Science in Analytics at North Carolina State University (NCSU) received nearly 800 applications for its Fall term.

1http://www.computerworld.com/s/article/9247861/Career_alert_A_Master_of_analytics_degree_is_the_ticket_if_you_can_get_into_class
More important than this evidence for a growing demand for the kind of preparation provided by an Operations Research/Operations Analytics curriculum, Iowa State has the deep expertise to serve students exceptionally well through this revitalized, interdisciplinary program. For these reasons IMSE and Statistics propose a name change for the program and plan to update the requirements for the degree consistent with these needs and opportunities.

A side-by-side comparison of the Operations Analytics MS Program and the existing, though outdated, Operations Research MS, follows. As the attached pages make clear, the same basic objectives and intellectual content remain from the Operations Research program; the terminology and some of the tools have been modernized particularly through the addition of Computer Science and Economic courses to the electives in the renamed and updated Operations Analytics program.
Program Description

Revised Name of Program: M.S. in Operations Analytics

Administering Departments: IMSE and Statistics

Collaborating Departments: Computer Science, Mathematics, and Economics

Revised Program Admission Requirements/Prerequisites:

Undergraduate courses or demonstrated competency in
- Multivariate calculus
- Linear algebra
- Basic calculus-based probability
- Applied statistics through multiple regression
- Introductory computer science/programming
- Basic optimization

Students with one or more deficiencies in these prerequisites may be admitted to the program on a provisional basis, but deficiencies must be made up within the first year of study and courses used to make up the deficiencies may not appear on the POS.

Revised Degree Requirements:

- Prerequisites as specified above
- Graduate admission by both IMSE and Statistics Departments
- Formation of a POS committee with at least one member from each of the IMSE and Statistics Departments
- Completion of one of the core programs specified below
- A total of 30 credits of coursework from an approved course list specified below subject to a restriction on the number of course credits that may come from courses with primary listing in a single department
- A 3 credit (credits not included in the 30 in the previous bullet) Creative Component on a topic in modern analytics supervised by a member of a sponsoring or collaborating department
- A final oral exam

Revised Core Programs:

All graduates of the program will include a (new) 3 credit capstone analytics course IE/Stat/CS 504X on their POS. This course will consist of a large-scale group project in analytics, potentially with an external partner. A proposed catalogue course listing is:
IE/Stat/CS 504X Operations Analytics Capstone (3 credits)
Prerequisites: Unrestricted admission to the Operation Analytics M.S. program and completion of 18 credits toward the degree, including 12 course credits of a core option in the program.
Capstone design course based on a substantial team project that integrates the elements of learning from a large-scale set of data sources and utilization of modern computational tools to use what is learned to improve some aspects of the operation of a real complex system. This will include problem formulation, mining of available data, modeling and analysis, the development of conclusions and recommendations and the presentation of those in oral, poster, and written report forms.

This course will be part of an 18 credit program core. Two options will be available for this core.

Core Option 1 (18 credits)
All of:
• IE/Stat/CS 504X Operations Analytics Capstone (3 credits)
• IE 513 Analysis of Stochastic Systems (3 credits)
• IE 534 Linear Programming (3 credits)
• IE 583 Knowledge Discovery and Data Mining (3 credits)
Two of:
• IE 508 Design and Analysis of Allocation Mechanisms (3 credits)
• IE 519 Simulation Modeling and Analysis (3 credits)
• IE 564X Decision Analysis in System Design (3 credits)
• IE 582 Enterprise Modeling and Integration (3 credits)

Core Option 2 (18 credits)
All of:
• IE/Stat/CS 504X Operations Analytics Capstone (3 credits)
• Stat 500 Statistical Methods I (4 credits)
• Stat 542 Statistical Theory I (4 credits)
• Stat 579 An Introduction to R (1 credit)
• Stat 502X Modern Multivariate Statistical Learning (3 credits)
• Stat 444 Bayesian Data Analysis (3 credits)

Revised Program Electives:

The remaining 12 credits of the required 30 course credits may be drawn from courses listed in the core options or from the following lists of courses, subject to the restriction that students electing Core Option 1 must include at least 6 credits outside of IE and students electing Core Option 2 must select at least 6 credits outside of Statistics.

IMSE Elective Courses
• IE 631 Nonlinear Programming (3 credits)
• IE 632 Integer Programming (3 credits)
• IE 633x Stochastic Programming (3 credits)
• IE 634 Computational Optimization (3 credits)

Statistics Elective Courses
• STAT 432 Applied Probability Models (3 credits)
• STAT 503 Exploratory Methods and Data Mining (3 credits)
• STAT 551 Time Series Analysis (3 credits)
• STAT 580 Statistical Computing (3 credits)
• STAT 585X Data Technology for Statistical Analysis (3 credits)

Computer Science Elective Courses
• COM S 526 Parallel Computing (3 credits)
• COM S 555 Simulation: Algorithms and Implementation (3 credits)
• COM S 556 Analysis Algorithms for Stochastic Models (3 credits)
• COM S 572 Principles of Artificial Intelligence (3 credits)
• COM S 573 Machine Learning (3 credits)
• COM S 673 Advanced Topics in Computational Intelligence (3 credits)

Mathematics Elective Courses
• MATH 314 Graphs and Networks (3 credits)
• MATH 554 Introduction to Stochastic Processes (3 credits)
• MATH 565 Continuous Optimization (3 credits)
• MATH 566 Discrete Optimization (3 credits)

Economics Elective Courses
• ECON 571 Intermediate Econometrics (3 credits)
• ECON 600 Quantitative Methods in Economic Analysis II (3 credits)

Other electives may be proposed for use on a POS. Their approval will require unanimous consent of a program administrative committee consisting of a representative from each administering department.

Creative Component:

Each student will write a formal individual creative component paper on a topic related to operations analytics under the supervision of a faculty member from an administering or collaborating department. Three "599" credits will be earned for this creative component.
Side-by-Side Comparison of Existing Joint IMSE/Stat MS Program in "Operations Research" and Proposed Modernization (Pending Approval of Naming Update to "Operations Analytics")

**PREREQUISITES**

<table>
<thead>
<tr>
<th>Existing OR Program</th>
<th>Proposed Revision</th>
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<tbody>
<tr>
<td>Math 265 (Multivariate Calculus), Math 307 (Linear Algebra)</td>
<td>Multivariate Calculus, Linear Algebra</td>
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<tr>
<td>Math 266 (Differential Equations)</td>
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<tr>
<td>IE 312 (Linear Programming), IE 313 (Stochastic Analysis)</td>
<td>Basic Optimization, Basic Calculus-Based Probability</td>
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<td>IE 304 (Engineering Economy)</td>
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<tr>
<td>Stat 231 (Probability and Statistics for Engineers), Stat 341 (Probability Theory)</td>
<td>(Basic Calculus-Based Probability and) Applied Statistics Through Multiple Regression</td>
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<td>Introductory Computer Science and Programming</td>
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**GOVERNANCE AND POS COMMITTEES**

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<th>Existing OR Program</th>
<th>Proposed Revision</th>
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<tr>
<td>Jointly Administered by IMSE and Statistics</td>
<td>Jointly Administered by IMSE and Statistics</td>
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<tr>
<td>Advisor from IMSE or Statistics and Both Departments Represented on POS Committee</td>
<td>Both Departments Represented on POS Committee</td>
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<td>CC on Analytics Topic and Supervised by an Advisor from IMSE or STAT or Collaborating Department (MATH, CS, or ECON)</td>
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**EXAMS**

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<tr>
<th>Existing OR Program</th>
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<tr>
<td>Written Exam Over 2 IE and 2 Stat Courses Required for the CC Option</td>
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<tr>
<td>Final Oral</td>
<td>Final Oral</td>
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REQUIRED CREDITS REQUIRED AND DISTRIBUTION

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<tr>
<th>Existing OR Program</th>
<th>Proposed Revision</th>
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<tr>
<td>34 Credits Total (including a maximum of 6 for a thesis or 4 for a CC)</td>
<td>33 Credits Total (including 3 for a CC)</td>
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<tr>
<td>At Least One Course in Each of the Areas Below (At Least One With Primary Listing in IE and at Least One With Primary Listing in Stat):</td>
<td>One of Two Approved Core Programs:</td>
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<td>• Simulation</td>
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<td>o IE 519 Simulation and Modeling Analysis</td>
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<td>• Data Analysis</td>
<td>• IE/Stat/CS 504X Operations Analytics Capstone (3 credits)</td>
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<td>o STAT 500: Statistical Methods</td>
<td>• IE 513 Analysis of Stochastic Systems (3 credits)</td>
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<td>• Economic Analysis</td>
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<td>o IE 514 Advanced Material Control</td>
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<td>o STAT 531 Statistics for Quality and Productivity</td>
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<td>o STAT 539 Game Theory</td>
<td>• IE 508 Design and Analysis of Allocation Mechanisms (3 credits)</td>
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<td>o STAT 544 Bayesian Decision Making</td>
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<td>• Optimization</td>
<td>• IE 564X Decision Analysis in System Design (3 credits)</td>
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<td>o IE 534 Mathematical Programing I</td>
<td>• IE 582 Enterprise Modeling and Integration (3 credits)</td>
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<td>o IE 631 Nonlinear Programming</td>
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<td>• Probabilistic Modeling</td>
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<td>o STAT 542 Theory of Probability and Statistics</td>
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Core Option 2 (18 credits)
All of:
• IE/Stat/CS 504X Operations Analytics Capstone (3 credits)
• STAT 500 Statistical Methods I (4 credits)
• STAT 542 Statistical Theory I (4 credits)
• STAT 579 An Introduction to R (1 credit)
• STAT 502X Modern Multivariate Statistical Learning (3 credits)
• STAT 444 Bayesian Data Analysis (3 credits)
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<td>• IE 419 Manufacturing Systems Modeling</td>
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<td>• IE 512 Queuing Theory and Applications</td>
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<td>• IE 512 Scheduling and Inventory Theory</td>
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<td>• IE 534 Linear and Goal Programming</td>
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<td>• IE 536 Software Reliability and Management</td>
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<td>• MATH 690V Optimization Theory</td>
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Academic Program Approval Voting Record

This document is to be appended as the last page of the proposal for any new or revised academic program to record the successive votes of approval as the proposal moves through its required review and approval steps. Consult Faculty Handbook Section 10.8 or the Faculty Senate Curriculum Committee website for information regarding Committee review and voting requirements for each action.

Curricular Action: (check appropriate boxes below)

1. □ New Program  ☐ Name Change  □ Discontinuation  □ Concurrent Degree for:
2. □ Undergraduate Major  ☐ Graduate Major  □ Undergraduate Minor  □ Graduate Minor
   □ Undergraduate Certificate  □ Graduate Certificate  □ Other: ___________________________
3. Name of Proposed Change: ___________________________ M.S. in Operations Analytics
4. Name of Contact Person: _____Prof. Janis Terpenny_____ e-mail address: terpenny@iastate.edu
5. Primary College: _____________________ Secondary College: _____________________
6. Involved Department(s): IMSE _____________________ Statistics _____________________

Voting record for this curricular action:

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