

Concept Paper:

ME/MS Health Systems Engineering

Kate Gleason College of Engineering

Industrial and Systems Engineering

Biomedical Engineering

College of Health Sciences and Technology

Health Systems Administration

Biomedical Sciences

March 2014

I. ME/MS Health Systems Engineering

**Kate Gleason College of Engineering
Industrial and Systems Engineering**

**College of Health Sciences and Technology
Health Systems Administration/Biomedical Sciences**

II. Describe goals and justification for proposed program

Justification:

- Health care is a growing sector of the economy – now the second largest sector of economy, accounting for 17.4% of the United States Gross Domestic Product in 2012.
- Cost of health care is high and rising. Costs in the US for 2012 were \$2.8 trillion, or \$8,915 per person. – IE tools and techniques can create efficiencies in all aspects of care delivery.
- Affordable Care Act leading to significant changes. The main focus of these changes is the demand for measurable increases in efficiency and effectiveness of care delivery and cost reductions.
- Technology is a critical element of health care reform, e.g., EMR creating new discipline “Smart and Connected Health” (NSF). Electronic medical records will be deployed to manage, track and measure treatment effectiveness, patient satisfaction, provider reimbursement and process improvement.

Goals:

- Provide current and future managers with the technical expertise to lead efficient health care systems.
- Identify needs, model, analyze and improve the health care systems
- Perform research to develop innovative approaches to transform healthcare from reactive to proactive (NSF and NIH initiative)
- Understand structure of US healthcare system, along with socio-economic, legal and regulatory issues
- Collaborate with local, regional, federal healthcare providers to develop co-ops and capstone projects that lead to highly visible implementations

Focus Area Goals:

- Provide better devices and delivery Systems
- Improve care for the aging
- Improve the effectiveness and efficiency of health care delivery
- Reduce costs of health care and improve patient satisfaction
- Engineer better medicines
- Develop efficient bioanalytical systems
- Advance health informatics and physiological modeling

III. Description of the new program: Summarize program curriculum and other program aspects

Both and ME and MS degree in Health Systems Engineering are proposed. Both are described below. The courses presented are already offered unless otherwise indicated (*indicates currently offered online).

ME Degree 33 Hours

Required (21 hours):

ISEE XXX Introduction to Healthcare Systems Engineering (to be developed)

ISEE XXX IE Methods for Healthcare Systems (to be developed)

ISEE 792 Engineering Capstone

*HLTH 715 Reinventing Health Care

*HLTH 730 Finance for Healthcare Professionals

*HLTH 737 Lean Sigma Application in Health Care

*HLTH 760 Health Care Informatics

Electives (12 hours):

KGCOE Electives (at least 6 hours)

*ISEE 626 Contemporary Production Systems

*ISEE 661 Linear Regression Analysis

*ISEE 703 Supply Chain Management

*ISEE 723 Global Facilities Planning

*ISEE 750 Systems and Project Management

*ISEE 751 Decision & Risk Benefit Analysis

*ISEE 752 Decision Analysis

*ISEE 760 Design of Experiments

*ISEE 771 Engineering of Systems I

*ISEE 772 Engineering of Systems II

*CQAS 775 Design and Analysis of Clinical Trials

ISEE 601 Systems Modeling & Optimization

ISEE 704 Logistics Management

ISEE 710 Systems Simulation

ISEE 711 Advanced Simulation

ISEE 720 Production Control

ISEE 728 Production Systems Management

ISEE 730 Biomechanics

ISEE 731 Advanced Human Factors/Ergonomic

ISEE 732 Systems Safety Engineering

HST Electives (at least 3 hours)

*HLTH 700 Research Methods

*HLTH 710 Governance, Law, Policy, and Economics

*HLTH 725 Health Care Leadership

*HLTH 717 Bioethics

*HLTH 723 Human Resources in Health Care

*HLTH 732 Health Insurance & Reimbursement

*HLTH 720 Health Care Planning

MS Degree 30 Hours

Same as ME, but with 6 hours electives and 3 hours of capstone replaced by:

ISEE-790 Research and Thesis

ISEE-795 Graduate Seminar I (0 credit)

ISEE-796 Graduate Seminar II (0 credit)

IV. Describe new program's fit with RIT Academic Portfolio Blueprint Characteristics and criteria

The Health Systems Engineering programs align with RIT's mission, vision, and values and supports the strategic alignment with Rochester General Hospital. Students will apply the fundamental knowledge of industrial and systems engineering concepts to health-related areas, interleaved with a broad understanding of healthcare systems. The proposed program is rich in opportunities for student engagement and innovative research. It is easy to envision high-quality multidisciplinary projects focused on the technological challenges associated with the improvement of the delivery and quality of health care processes and services.

Health care is one of the largest sectors of the US economy, measured as a fraction of gross domestic product, and delivery of health care services is perhaps the most visible component. Concerns over the access to high quality affordable health are a global issue, creating a demand for graduates with abilities to lead and transform health care organizations. The robust curricula described above effectively utilizes faculty expertise, provides traditional and innovative approaches, and is financial viable.

V. Synergy with other programs: Describe curricular linkages with other academic programs and associated interdisciplinary connection. Provide evidence of Dean support when program uses specific courses, resources, etc. from another college

The programs directly connect ISE (KGC OE) with HLTH (CHST), as well as integration with other engineering programs, particularly Biomedical Engineering and the Center for Quality and Applied Statistics (CQAS). In addition, KGC OE and CHST have already devoted significant resources to support health care initiatives including faculty recruitment, laboratory space, and startup funding. Infrastructure exists to support research, including new facilities in CBET and Institute Hall. Collaborative relationships have been established with several faculty members from other colleges, particularly the College of Applied Science and Technology, the College of Science, and NTID, as well as Rochester General Hospital, University of Rochester, and multiple industry sponsors. These partnerships have resulted in joint proposal submissions, funded projects, and publications.

VI. Administrative structure for the new program

The ME/MS in Healthcare Systems Engineering will be offered jointly by the Kate Gleason College of Engineering (KGC OE) and College of Health Sciences and Technology (CHST). The programs will be administered by a Program Coordinator within the Industrial and Systems Engineering Program (ISE). The program coordinator will perform administrative duties under the supervision of the ISE Department Head. Instructional responsibilities will be assumed by faculty of the associated departments/colleges, as necessary. It is anticipated that, in addition to traditional formats, courses will be delivered in an online format to maximize the convenience of the target market of students.

VII. Enrollment Management Expectations and Sustainment: Discuss projected enrollment, marketability and future sustainability of program based on requested input and guidance from Enrollment Management and Career Services

We are proposing both an on-campus and fully online program, using existing courses from ISE and HSA (indicated with an asterisk). Initially, no new faculty will be required and the two participating departments will handle the administrative tasks with existing resources.

We expect that RIT graduates from the ISE, HSA and health-related BS programs will find the degree attractive. About 50% of ISE undergraduate students complete a BS/ME or BS/ME degree creating a pool of nearly ~25 students per year. In addition, enrollment in the ISE BS program is experiencing growth, in part due to the expansion of IE into contemporary applications of healthcare and energy. We have experienced growth in our ME/MS Sustainable Engineering programs, which we believe will be a model for growth of this proposed program. In about 5 years, Sustainable Engineering has led to incremental growth of ~15 full time graduate students. We also believe it is highly marketable to RIT alumni and working professionals across the country.

With the continued growth of health care, via governmental reform, we project that health systems engineers will be in great demand each year of the Affordable Care Act's rollout.

We estimate an online program, marketed nationally, should see an initial conservative enrollment of 8-10 students the first term it is launched. This is a conservative number.

Below is a set of questions posed by Diane Ellison, Assistant Vice President, along with our responses.

What is the market for this degree?

From the BLS web site: <http://www.bls.gov/ooh/architecture-and-engineering/industrial-engineers.htm>

Employment of industrial engineers is projected to grow 5 percent (for a total of 10,100 new IE jobs) from 2012 to 2022. This occupation is versatile both in the nature of the work it does and in the industries in which its expertise can be put to use. In addition, because industrial engineers' work can help with cost control by increasing efficiency, these engineers are attractive to employers in most industries.

Industrial engineers are employed in a wide range of industries, including major manufacturing industries, hospitals, consulting and engineering services, and research and development firms. This versatility arises from the fact that these engineers' expertise focuses on improving products and processes, e.g., reducing costs, improving quality and safety, and championing sustainability, making their work valuable for many industries. Growth in health care and changes in how care is delivered will create demand for industrial engineers. Inquiries from prospective students, at the undergraduate and graduate levels, have increased significantly in recent years and there are now nearly 50 IE programs offering programs, e.g., certificates, BS options, ME, MS, focused on healthcare systems. However, only a few of these programs offer a standalone graduate degree.

From the Society for Health Systems web site: <http://www.iienet2.org/SHS/details.aspx?id=18278>

Industrial engineers work in a variety of jobs in hospitals and HMOs. Typical projects might involve process analysis, time and cost studies, facility design, simulation, process and quality improvement, financial and organizational planning, and information system design. IEs in health care often are called management engineers (MEs) or have other job titles, but many of the tasks and skills are much the same as IEs in any other industry.

As in most other industries, the possible career paths and day-to-day job responsibilities vary and are nearly limitless. The slides below summarize many typical and less typical projects on which IEs might find themselves working within health care.

What background will potential students need in order to apply? Can they have an engineering or health-related BS degree?

Applicants should have a baccalaureate or equivalent degrees in engineering. Students with degrees in healthcare, science, or other related fields will be considered on a case-by-case basis. There will be a pool of healthcare professionals with significant college science course work who will want to enter into the field of systems engineering. We will also market directly to this audience. Bridge work may be required to ensure appropriate technical background.

How would this compete with the current MS Applied Statistics or the MS in Health Systems Administration?

There is little to no overlap with the MS in Applied Statistics. Currently, CQAS offers only one or two related course that could be added as electives to the proposed program. The program would also present minimal competition for the current MS in Health Systems Administration. A large majority of health care professionals would not be inclined to pursue a systems engineering degree by nature of their clinical education and desire to work in departments focused on patient care delivery or facilitation.

There will be some health care professionals, however, who have expanded their knowledge and work into areas of quality, quality control, process management and process improvement. These individuals might have sufficient experience and on-the-job acquired expertise in systems engineering. While they might be a small group of professionals, this program would appeal to them over other health-related MS degrees.

Systems Engineering?

Systems engineering is typically viewed as an interdisciplinary engineering field that focuses on the design of complex systems. It is rooted in a systems engineering process for allocation to and integration of functional systems, e.g., hardware, software, and human, in order to meet systems requirements. The focus of systems engineering programs are on the technical aspects related to the process. We are not aware of any systems engineering programs that consider health systems, not would be expect that potential students would look in this area.

The degree will compete with other health-related degrees, both management and administration in nature. A primary feature of this offering exists in its uniqueness: the program gives both industrial engineers and health care professionals an additional, robust, standalone option.

Key competitors?

Most key competitors offer options or focus areas in health systems engineering, but rarely offer a standalone programs. The most similar programs are MEng Healthcare Systems Engineering at Lehigh University <http://www.lehigh.edu/healthcaresystems/> and Executive MS in Health Systems at Binghamton. <http://www.binghamton.edu/ssie/grad/mshs-nyc/>.

Other programs include:

Marquette University/Medical College of Wisconsin: M.S., Healthcare Technologies Management <http://www.marquette.edu/engineering/hctm/index.shtml>. This program focuses on biomedical product development.

NJIT: MS Healthcare Systems Management <http://catalog.njit.edu/graduate/programs/healthcaresysgmt.php>. This program has little distinction from a standard MS IE. No health systems courses!

Others with options or select courses: Clemson, Missouri S&T, Northwestern, Michigan, Penn State, Purdue, Texas Tech, Wayne State.

What would be the value proposition for this degree, for the individual who would enroll? Better job? Credential required to get a job/promotion?

Obviously, most graduate degrees will open doors for recipients, provided the jobs exist. The value proposition for the degree can be outlined this way:

- Health care is the largest growing industry in the US and job growth is expected to be greater than average (BLS, 2014)
- Industrial engineers will have more job opportunities as health care organizations expand their systems engineering efforts
- Health care organizations are actively employing systems engineering methods for delivery and treatment improvements
- Our program will be offered to students seeking full or part-time study
- Our program can be completed as an ME or MS degree
- Our program can be completed on-campus in a blended format (with all health systems courses offered only online)
- Our program can be completed entirely online
- Our program is an entirely freestanding unique degree program, not a just a concentration or option in an existing program
- Our program is a genuine interdisciplinary program between the industrial systems engineering and health systems administration departments
- RIT's ISE and HSA departments have been offering degree for decades and have an established credibility and track record
- Both departments have hundreds of alumni to recruit from and validate the quality of their programs

Below is an email from Diane Ellison in response.

From: Diane Ellison
Sent: Thursday, March 13, 2014 6:46 PM
To: William Walence; Scott Grasman
Cc: James G. Miller (EMCS VP); Daniel Ornt
Subject: Health Systems Engineering Concept Paper

We have reviewed the concept paper for the MS/ME Health Systems Engineering. The program is appealing in that it targets a new market segment, the success of which is based on collaboration between your departments here at RIT. Following is our feedback regarding enrollment potential:

While you propose the program as both campus-based and online, the actual program format and delivery, as well as the market for each are very different. A fully online program would be marketed to working professionals, the majority of whom would complete the program on a part-time basis. A campus based program would target primarily full-time students, and given our experience a significant percentage of the market would be international. It is important to consider these two different markets, and also the unique program model that would be required to serve them. With that in mind, we provide two separate enrollment estimates based on the two different program models.

- 1) Online Program/market: For a fully online program and market the 8 – 10 new student number you propose for the first year and in subsequent years is reasonable. It is likely that these students will be part-time, and if the program is fully online we assume they would be charged at the RIT Online tuition rate. Given this, there would be no institutional scholarship support for these students.
- 2) The campus-based program you describe in the concept paper is not viable for the international student market. Immigration regulations allow international students to take one online course per term, and certain government sponsors limit online courses even further (eg. Saudi Arabian government allows only two courses for the entire degree and requires approval in advance for those courses). The fact that all 5 required health systems courses are online only, and depending on the format of the two new courses you propose, the campus-based option you present is not viable for the full-time, international student market.

This being said, we do agree that there is potential to enroll 15 new students per year in a campus-based program. In this case the program model would need to consist of at most 2 or 3 required online courses, with the rest being offered through on-campus delivery targeted to a full-time, campus-based population. We would expect that a significant percentage of this enrollment would be international students.

In both of these models, developing the program to appeal to and enroll students with backgrounds in medical sciences, physical sciences, mathematics and other areas as well as engineering would increase demand. In addition, allowing students to begin and take courses in the program in fall, spring, or summer terms will increase enrollment potential.

Let me know if you have questions,
Diane

Diane Ellison
Assistant Vice President

VII. Impact on Resources: Describe impact of proposed program on resources:

- **Utilization of Existing Resources: Elaborate on how this program will use resources already assigned to the academic unit / college (space, faculty / staff) etc. and the plan for reorganization or re-allocation of resources.**

We already have most of these courses, and many are available online. Resources for course development to create new course and modify courses for online delivery will be provided during summer session. Faculty are currently engaged in research in this area are highly committed and dedicated to this program and will bear startup workload. As the program grows an additional faculty member will be requested, perhaps with a joint appointment. The Deans of KGCoe and CHST, as well as other leaders at RIT, consider this initiative as a prime opportunity to engage donors from this community.

- **Cost Model Analysis: summarize 5-year revenue and cost projections taken from Concept Paper Cost Model Template.**

The cost model was reviewed with Jackie Taylor and set up based upon the following assumptions:

- Both departments have sufficient courses for the proposal except for two specialized health systems courses which would need development
- Some of the existing IE courses are not offered online and would need conversion for the online version of the program
- All of the health systems courses are already available entirely online
- The health systems courses employed in the program can be converted to on-campus versions, if necessary for marketing purposes, otherwise they can be taught in the online format
- Both departments currently have sufficient capacity to provide the necessary courses, faculty and staff for these programs with minimal new resources
- The key feature of the new program is effective utilization of existing courses and faculty with minimal development costs and overhead
- New resources are noted on the cost template

IX. Conclusion

The above proposal for an ME and MS program in Health Systems Engineering is a concept whose time has come. The program is leading edge in its approach and curriculum. It meets a growing need in a burgeoning US industry. It is built on two solid RIT platforms utilizing an interdisciplinary approach and existing resources.

Post-vetting

X. Summary of community input, response to input, and new program costing data and tables, (this information is added to concept paper and forwarded by dean to Provost for final review and approval to proceed to full program proposal development)