Healthcare Systems Engineering Programs

José Zayas-Castro, PhD
Professor, Industrial & Managements Systems Engineering (IMSE)
Associate Dean for Research, College of Engineering

Collaborators:
Peter Fabri, MD, PhD, College of Medicine, USF
Florentino Rico, MS; IMSE at USF
Monica Puertas, MS, IMSE at USF
Ron Rardin, PhD, IE at University of Arkansas
Healthcare Systems Programs

- Most offered through
  - Public Health,
  - Schools of Medicine,
  - Health Administration, or
  - Health Care Management Departments

- Engineering certificates
  - Graduates: 2
  - All professionals: 3
  - Undergrads and 1st year grad-students: 1

- Health school certificates
  - Graduate: 19
  - All professionals: 3
Health Systems Engineering Alliance (HSEA)

• An association of academic programs that includes research focused on engineered solutions to improve disease prevention and healthcare delivery.
• Includes 39 members from US and Canada
• “HSEA focuses on the application of its engineering-based tools to integrate resources, refine operations, and aid clinical decisions with the goal of making healthcare delivery systems and processes consistent, high quality, and cost-effective over the entire course of patient care, including prevention.”¹

¹https://catalyze care.org/groups/hsea
Healthcare Systems Engineering Programs*

1. University of Southern California - Master of Health Systems Management Engineering
   Los Angeles, CA

2. Texas Tech University - MS Healthcare Engineering - Healthcare Engineering Option in the Master of Engineering Degree
   Lubbock, TX

3. Georgia Institute of Technology - MS in Health Systems
   Atlanta, GA

4. Stanford University - MS Degree in Health Services Research
   Stanford, CA

5. University of Missouri - Dual MS in Industrial Engineering (MSIE) & Master of Health Administration (MHA)
   Columbia, MO

6. Lehigh University - MS Healthcare Systems Engineering
   Bethlehem, PA

   Ann Arbor, MI

8. University of Arkansas - MSIE - emphasis on Healthcare Systems Engineering
   Fayetteville, AR

   Flint, MI

10. Northeastern University - Healthcare Industrial Engineering Minor (undergraduate)
    Boston, MA

    Raleigh, NC

12. University of Wisconsin - PhD, Health Systems specialization
    Madison, WI

13. Massachusetts Institute of Technology - MS Degree in Engineering Systems: Healthcare Systems Track
    Boston, MA

*Healthcare systems engineering programs based on information available online as of 08/30/2013
Example Areas of Emphasis

Quantitative Methods
- Risk Modeling/Assessment
- Queuing Theory
- Design of Experiments
- Decision Theory
- Computer Simulation
- Multivariate Statistical Analysis

Healthcare Management
- Coding and Healthcare Law
- Clinical Practice Management
- Financial Engineering
- Economic Concepts Applied to Health
- Financial Management of Health Services

Process Improvement
- Six-Sigma Quality Resources
- Health Care Operations Improvement
- Performance Analysis
- Quality Management for Engineers

Information Systems
- Software Project Management
- Biomedical Informatics
- Enterprise Wide Information Systems

September 20, 2013
Typical Requirements

• Graduate Programs (mostly MS)
  – BS in engineering, mathematics, sciences, or related fields
  – 30-45 credit hours (for a PhD is higher)
  – Overall undergraduate GPA of 3.0 or better
  – Satisfactory scores on the Graduate Record Examination (GRE)
Graduate Programs’ Audience

Professionals with:

- Strong quantitative skills
- Degrees in engineering, sciences, or applied social science
- Interest in operations management and health care applications
- Interest in additional technical and management responsibilities within healthcare organizations
Variation-Intersection @ USF between Engineering and Medicine

Aims (Peter and José):

- “Bidirectional bilingualism”

- Scholarly concentration - @ USF- College of Medicine
  - Spillover: some medicine students in IE certificates or masters

- Status: Proposal on an MS in HSE (bringing IE, Medicine and Public Health students “together”)
**HSE Education: Enhancers vs. Inhibitors**

<table>
<thead>
<tr>
<th>Enhancers</th>
<th>Inhibitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Market/Industrial support &amp; sponsors</td>
<td>• Lack of market support/sponsors</td>
</tr>
<tr>
<td>• Funded research opportunities</td>
<td>• Lack of funded research</td>
</tr>
<tr>
<td>• Job opportunities</td>
<td>• Lack of jobs</td>
</tr>
<tr>
<td>• “Multiple champions”</td>
<td>• “One person show”</td>
</tr>
<tr>
<td>• Collaborative/unselfish - share incentives</td>
<td>• Cultural/power/territorial clashes</td>
</tr>
<tr>
<td>and success</td>
<td></td>
</tr>
<tr>
<td>• Creative/flexible in curricular development</td>
<td>• Inflexible in curricular development</td>
</tr>
<tr>
<td>• Willingness to venture and embrace change</td>
<td>• Resistance to change, Status quo</td>
</tr>
<tr>
<td>• “Smooth” bureaucratic processes</td>
<td>• Bureaucratic processes</td>
</tr>
<tr>
<td>• Dual delivery mode: online and on campus</td>
<td>• Just on campus?</td>
</tr>
</tbody>
</table>
Healthcare Systems Engineering Job Profile*

Required Experience

• 1-5 years for project managers or quality engineers
• +7 years for senior positions

Job titles

• **Process Improvement Analyst** or Health Center Process Improvement Specialist; process engineer, Manager for Strategy & Operations; Health Care Providers Performance Improvement; Healthcare Industrial Engineer; Continuous Quality Clinical Documentation Improvement specialist; Business Process analyst; Lean Six Sigma Black Belt Analyst

• **Data Analyst or Healthcare Analytics** Manager; Data management; Quality Data Analyst; Healthcare/Big Data/Image Processing; Principal Research Engineer

• **Quality engineer** or Senior Quality Assurance Engineer, Sr. Quality Engineer - Regulatory/Quality Healthcare Diagnostics/Medical Instrumentation; Director, Division of Quality; medical device quality engineer; Design Quality Engineer; Product Engineer; Reliability Engineer

• **Healthcare Clinical Operations Consultant or Clinical Engineer**; Manager clinical quality analysis

• Health Economics and **Decision Support Consultant**

*Based on a job search on the IIE career center and the LinkedIn job search (as of 08/30/2013).
Thanks!
SUPLEMENTARY SLIDES/INFORMATION
<table>
<thead>
<tr>
<th></th>
<th>University</th>
<th>Department</th>
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<td>Arizona State University</td>
<td>School of Computing, Informatics and Decision Sciences Engineering</td>
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<td>3</td>
<td>George Mason University</td>
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<td>University of Arkansas</td>
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<td>Georgia Institute of Technology</td>
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<td>University of Calgary</td>
<td>Operations Mgmt, Haskayne School of Business</td>
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<td>5</td>
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<td>9</td>
<td>Missouri University of Science and Technology</td>
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<td>Ohio University</td>
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<td>Wayne State University</td>
<td>Industrial and Systems Engineering</td>
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<tr>
<td>17</td>
<td>Oregon State University</td>
<td>Mechanical, Industrial and Manufacturing Engineering</td>
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<td></td>
</tr>
<tr>
<td>18</td>
<td>Purdue University</td>
<td>Industrial Engineering &amp; Regenstrief Center</td>
<td>37</td>
<td>Western Michigan University</td>
<td>Industrial and Entrepreneurial Engineering</td>
</tr>
<tr>
<td>19</td>
<td>Rochester Institute of Technology</td>
<td>Industrial and Systems Engineering</td>
<td>38</td>
<td>Worchester Polytechnic Institute</td>
<td>Operations and Industrial Engineering</td>
</tr>
<tr>
<td>20</td>
<td>San Jose State University</td>
<td>Industrial and Systems Engineering</td>
<td>39</td>
<td>Youngstown State University</td>
<td>Industrial and Systems Engineering</td>
</tr>
</tbody>
</table>
Job search characteristics

• Search was conducted on LinkedIn (http://www.linkedin.com/job/home) and IIE (http://www.iienet2.org/)
• Keywords: healthcare engineer
• 37 job listings found
Job market needs

• “Responsible for analyzing large amounts of clinical and financial data and turning key findings into strategic recommendations to improve outcomes and drive cost of care efficiencies.” Fairview Health Services

• “This person will play a role in driving the agenda for evaluating and prioritizing improvement opportunities through the use of statistical analysis, modeling, and industrial engineering.” Medical University of South Carolina

• “Proven ability to design and lead complex data management and analysis projects; familiarity with clinical information, including diagnostic coding and clinical databases; and in-depth knowledge of statistical analysis and programs, research methods, epidemiologic study design, quality performance measurement, and quality improvement are all essential.” NYU Langone Medical Center
HCSE Job Profile

Desired knowledge and skills*

- Direct interaction experience with environments within the healthcare industry; familiarity with clinical information, medical terminology, including diagnostic coding and clinical databases
- Process mapping and root cause analysis
- Healthcare data analytics, research methodology, statistical analysis and sampling methods, Machine Learning, Informational Retrieval, and Image Processing
- Complex database management
- Reliability and Risk Management FTA, FMECA, DFMEA
- Certification on quality improvement, Lean, Six Sigma, GMP and/or ISO regulated environment, FMEA, DOE, quality tools
- Software knowledge/proficiency in Word, Excel, PowerPoint, Minitab, Visio, Project, Java, Python, .NET.

*Based on a job search on the IIE career center and the LinkedIn job search (as of 30/08/2013).

September 20, 2013
Employers

- Fairview Health Services
- Medical University of South Carolina
- American Academy of Pediatrics
- Fairview Health Services
- Holy Redeemer
- NYU Langone Medical Center
- American Academy of Otolaryngology
- TrueBridge Resoures
- Bloom Health
- Resources Global Professionals
- Optum Payer Market
- Humana
- Bureau of Naval Medicine and Surgery
- Allience HealthCare Services
- Smith & Nephew
- Siemens Healthcare Diagnostics Inc.
- API Healthcare
- MedSolutions
- Huron Consulting Group
- Siemens Healthcare Diagnostics Inc.
- NextGen Healthcare Information Systems
- CyberCoders
- Siemens Healthcare Diagnostics Inc.
- Siemens Healthcare Diagnostics Inc.
- Stoakley-Dudley Consultants, Ltd
- Johnson & Johnson
- STERIS Corporation
- Siemens Medical Solutions USA, Inc.
- Cyberonics
- Covidien
- Alere Analytics
- Geisinger Health System
- Planned Parenthood of the Pacific Southwest, Inc.
- The CSI Companies
- Kaiser Permanente
- Deloitte
USF Morsani College of Medicine
Health Systems Engineering Program

• A formal four year program that runs concurrently with the four years of medical school.

• Students apply for participation and are approved based on review of applications and interviews. There are typically 7-8 students per year.
USF Morsani College of Medicine Health Systems Engineering Program

- Year 1. Human Error and Patient Safety. Weekly one hour group meetings/discussions
- Summer 1. Research. Students prepare research proposals, weekly meetings on Advanced Excel and Minitab, individual mentoring.
- Year 2. Systems Modeling and Optimization. Weekly 1-hour meetings to review reading assignment and assigned homework problems.
- Year 3. Analytics and Data Mining. Weekly meetings to review assigned reading and assigned homework problems
- Year 4. Quality, LEAN, Six Sigma.
- Years 3 and 4. Conduct, perform, write manuscript for individual scholarly project in Health Systems Engineering.

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USF Morsani College of Medicine
Health Systems Engineering Program

Probability and Statistics
• Summer 1- Probability and Statistics workshop- eight 1-hour sessions reviewing probability, statistics, common methods, plus Excel, Minitab, RExcel
• Year 4- Applied Probability and Statistics for Clinicians – 2 hour small group workshop on using concepts of probability, conditional probability, and statistical inference in clinical medicine. Sources of error and bias.

Patient Safety
• Year 4- Human Error and Patient Safety- students register for a typical 4 week “block”, but attend a one semester, 3 credit hour graduate course together with graduate students from engineering, nursing, public health, and USF residency/fellowship program
• Year 4- Patient Safety Education Program- all students required to attend one-day workshop on teaching/using patient safety principles in clinical medicine
### Top Locations for Healthcare Engineer Jobs

Search was conducted on LinkedIn (http://www.linkedin.com/job/q-healthcare-engineer-jobs) as of 09/17/13.

#### Top locations for “Health-care” Engineer Jobs

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<tr>
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</tr>
<tr>
<td>New York</td>
<td>61</td>
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<td>Boston</td>
<td>51</td>
</tr>
<tr>
<td>Chicago</td>
<td>45</td>
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<td>Denver</td>
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<td>Washington</td>
<td>19</td>
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<tr>
<td>Minneapolis/Akron</td>
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<td>Cleveland/Akron</td>
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<td>123</td>
</tr>
<tr>
<td>Chicago</td>
<td>107</td>
</tr>
<tr>
<td>Richmond</td>
<td>64</td>
</tr>
<tr>
<td>Dallas/Fort Worth</td>
<td>58</td>
</tr>
<tr>
<td>Washington D.C.</td>
<td>54</td>
</tr>
<tr>
<td>Houston</td>
<td>49</td>
</tr>
</tbody>
</table>
“Formed in 2010, BAHM is a collaborative non-profit organization comprised of business schools committed to the belief that management education, applied to the challenges of healthcare delivery and healthcare innovation, plays a special role in creating new and important solutions”².

- Arizona State University W. P. Carey School of Business
- Boston University School of Management
- Duke University Fuqua School of Business
- Harvard Business School
- Northwestern University Kellogg School of Management
- University of California – Berkeley
- University of Colorado – Denver
- University of Minnesota Carlson School of Management
- University of Pennsylvania Wharton School of Business
- Vanderbilt University Owen School of Business
- Yale School of Management

² [http://www.bahm-alliance.org/about.php](http://www.bahm-alliance.org/about.php)