Influences and Trends in US Industrial Engineering:
One Perspective

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Overview

- Background
- Influences on IE Education and Research
- Educational Trends
- Research Trends
- Summary: Where we are going

A Little Background

Background

- 119 Industrial Engineering Departments in the USA (departments)
- Many have multiple degrees such as engineering management, operations research, industrial engineering (programs)
- Some *programs* are only offered at the graduate level; University of Texas OR
- The majority of undergraduates still get their first job in the manufacturing sector (*but...*)
- Until around 1998, most *accredited* IE departments were heavily OR and/or manufacturing at the undergraduate level
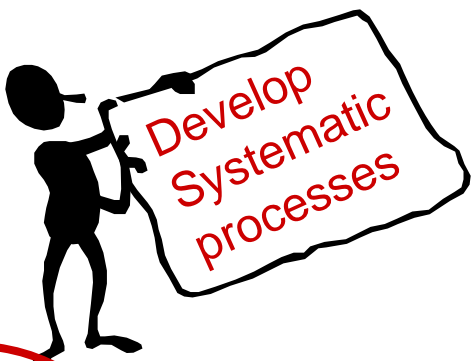
Influences

Contexts of USA IE Education, Research, and Practice

- **Social Context**
  - Population and Demographics
  - Health and Health Care
  - Security Implications
  - Sustainability
  - The Accelerating Global Economy (??)

- **Professional Context**
  - The Systems Perspective
  - Customerization
  - Public Policy
  - Public Understanding of Engineering
  - Building on Past Successes and Failures

Contexts of USA IE Education, Research, and Practice

- Implications for IE Education
  - An Aging Population
  - The Global Economy
  - Service-based Economy in US
  - The Five- or Six-Year Professional Degree
  - Distance education need
  - Teamwork, Communication, and Public Policy

Mission

Educational Objectives

Assess/Evaluate

Constituents

Learning Outcomes

Develop Systematic processes

Performance Criteria

Feedback for Quality Assurance

Educational Practices/Strategies

Evaluation: Interpretation of Evidence

Assessment: Collection, Analysis of Evidence

ABET 2000: *Assessment for Quality Assurance*

The Engineer of 2020 Reports

Another vision of the contexts for engineering in 2020:

Technological (e.g., bio-tech, digital systems, computer systems/tools, sustainable technology, interdisciplinary)

Societal, Global, and Professional (e.g., social, political & economic, diversity, multidisciplinary, global markets & contexts, interaction of engineering and public policy)

Attributes of the Engineer of 2020:

- Strong analytical skills
- Practical ingenuity
- Creativity
- Communication competencies (oral, written, and cultural)
- Business, management, and leadership skills
- High ethical standards and professionalism
- Agility, resilience, flexibility

Crisis Responses have also Shaped IE…

- Emergency preparedness/response (Hurricane Katrina; logistics)
- Energy issues (oil, nuclear, wind, water; logistics, economics, ergonomics)
- Conflict-related issues (Iraq; logistics, ergonomics, medical care)

Curriculum

Current Common Topics

- The most common topics required in US industrial engineering programs today are:

  – Probability and statistics

  – Economic analysis

  – Operations research and simulation

  – Quality methods

  – Project management

  – Ergonomics and work measurement / work design

Industry: Desired Skills for IE Graduates

1. Adaptable problem solving
2. Quantitative/analytical abilities
3. Creative and critical thinking
4. Interpersonal skills and presence
5. Teamwork skills
6. Decision-making ability
7. Technical writing ability
8. Process evaluation and analyses
9. Computer skills
10. Holistic problem solving
11. Project management
12. General engineering
13. Human dimension of management
14. Global perspectives
15. Leadership awareness

Emerging IE Topics (in priority order!!)

1. Ethical Behavior
2. Six Sigma
3. Lean Enterprise
4. Project management
5. Team Building and Facilitation
6. Leadership
7. Statistical Methods for Service Entities
8. Service Enterprise/Systems
9. Performance management/Measurement
10. Cognitive engineering

Emerging IE Topics

11. Enterprise Resource Management
12. Time to Market
13. Benchmarking
14. Human-integrated Systems/Usability/Ergonomics
15. New Product Development
16. Knowledge Management
17. Systems design concepts
18. Heuristic Optimization Methods
19. Financial Engineering
20. Sustainability

5 Emerging IE Programs/Degrees

- Service Engineering
  - A service system is a dynamic configuration of resources (people, technology, organizations and shared information) that creates and delivers value between the provider and the customer through service.

- Entrepreneurship
  - The organization, management, and assumption of risks of a business or enterprise, usually implying an element of change or challenge and a new opportunity.

- Systems Engineering/Engineering Systems
  - *Systems engineering* is an interdisciplinary approach and a means to enable the realization of successful systems. *Engineering systems* (MIT) is a multidisciplinary approach that does the same thing but has a management, policy, or social dimension as well as a technical one.

5 Emerging IE Programs/Degrees

- Industrial Ecology
  - Industrial ecology is the shifting of industrial process from open loop systems, in which resource and capital investments move through the system to become waste, to a closed loop system where wastes become inputs for new processes.

- Healthcare/Bioinformatics
  - Bioinformatics entails the creation and advancement of databases, algorithms, computational and statistical techniques, and theory to solve formal and practical problems arising from the management and analysis of biological data.

Research

Technological Context of USA IE Practice

- **Technological Change**
  - Breakthrough Technologies
    - Biotechnology
    - Nanotechnology
    - Materials Science and Photonics
    - Information and Communications Technology
    - Logistics
  - Technological Challenges
    - Physical Infrastructure
    - Information and Communications Infrastructure
    - The Environment
    - Technology for an Aging Population

Emerging Research Areas

- Energy (economics, logistics)
- Healthcare (aging)
- Cyber-xyz
- Supply chain management
- Manufacturing
  - Biomanufacturing
  - Sustainable manufacturing
  - Nano/miniature manufacturing
  - Manufacturing informatics

Summary

So what drives change in USA IE Departments??

- Resource availability
  - Grants received by faculty
  - Dept. chair, Dean, President are convinced it is their idea
- Perceived need
  - Industry
  - Administration (see above)
- Timing (of Resource availability with Perceived need)

Our Future??

- Curriculum
  - Healthcare
  - Management/"Soft" skills
  - Lean concepts
  - Degrees by distance

- Research
  - Supply chain/logistics
  - Nano-XYZ
  - Recycling/Green engineering/Energy
  - Aging

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Questions??

Thank You !!!