

Building a Health Systems Engineering Infrastructure

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August 17, 2009



Summary

- What is systems engineering?
- Where has it contributed to industries in the past?
- How is it contributing to health care delivery?
- How can we build an infrastructure for the future?

Systems Engineering

- Systems engineering is a field that goes by many names.....
 - Industrial Engineering
 - Operations Research
 - Management Science
 - Decision Science

“We don't make a lot of the products you buy. We make a lot of the products you buy better”



Scope

- Systems engineering includes many subfields of study:
 - Operations management
 - Quality engineering
 - Decision analysis
 - Simulation
 - Queuing
 - Optimization

History

Systems engineering emerged during World War II:

- Combination of British, Canadian, and U.S. Mathematicians and Scientists solving military problems:
 - Optimal size of convoys
 - U-boat detection strategies
 - Network interdiction

After WWII systems engineers focused on:

- Factory scheduling
- Transportation logistics
- Power network design
- Supply chain optimization



Service Industries

More recently systems engineering has been applied to service industries:

- Airlines
- Car rental agencies
- Hotels
- Amusement Parks
- Natural Gas and Power Industry



Energy Policy

Manne, A., Richels, R., Weyant, J. 1979, “Energy Policy Modeling: A Survey”, Operations Research, 27(1), 1-37.

“Inherently, energy policy is an interdisciplinary field. It involves economics, law, politics...and methodologies that are already familiar to the operations researcher: optimization algorithms, simulations, decision analysis and econometric estimation.”



Transportation Systems

Smith, B., Leimkuhler, J., Darrow, R. 1994, "Yield Management at American Airlines", *Interfaces*, 22(1), 8-31

"In its 1987 Annual Report American Airlines broadly described the function of yield management as "selling the right seats to the right customer at the right prices" "



Magic Kingdom

“Operation everything: It stocks your grocery store, schedules your favorite team's games, and helps plan your vacation.”, *The Boston Globe*

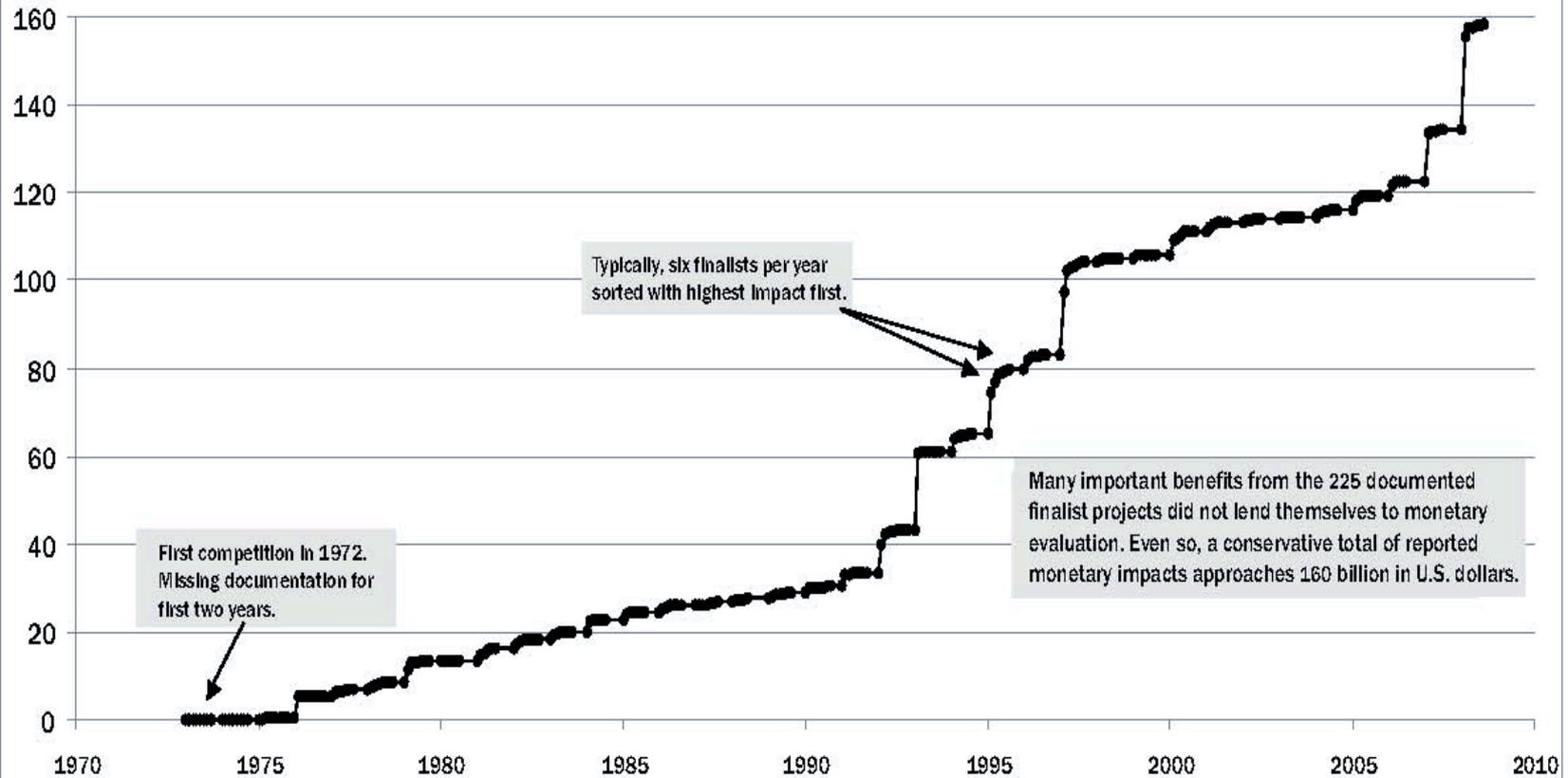
“Mark Eisner once told a reporter that his discipline "is probably the most important field nobody's ever heard of."He defines O.R. as "the effective use of scarce resources under dynamic and uncertain conditions.” ”



Measuring the Benefits

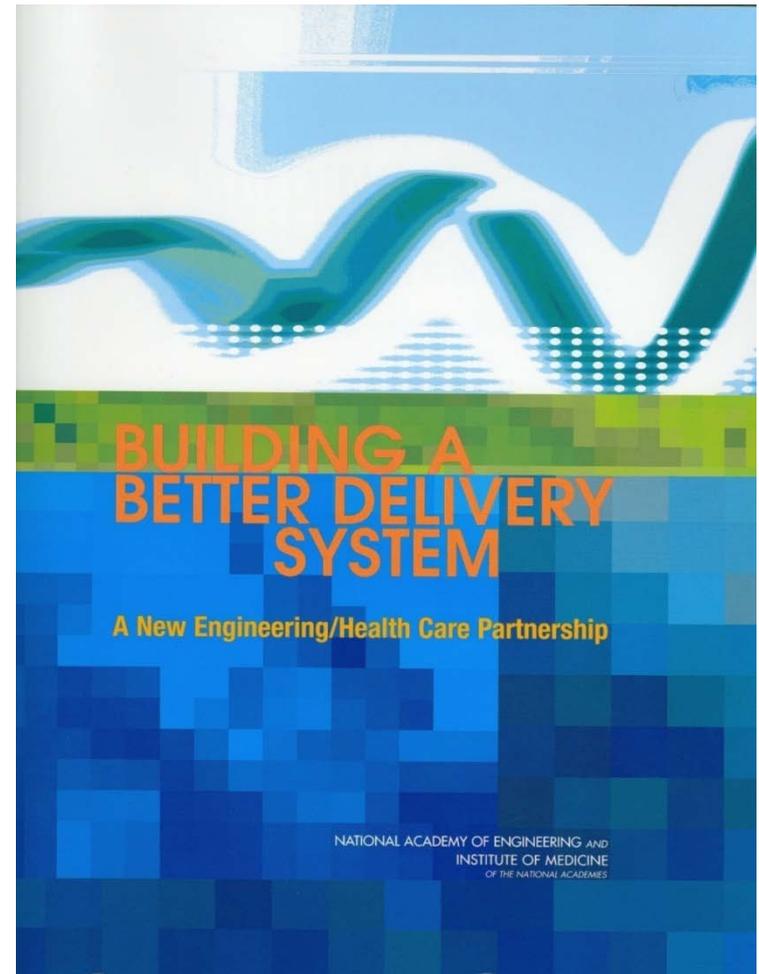
Grand Total Benefits in \$US Billions from Edelman Finalist Projects, 1972 through 2008

(Conservatively quantified benefits from documented projects, realized plus at most 2 years anticipated, in 2009 dollars)



Health Systems Engineering

- Recent enthusiasm has been generated in part by a joint report from the Institute of Medicine and the National Academy of Engineering



Current Research: Health Care Delivery

- Appointment systems
- Surgery planning and scheduling
- Hospital bed management
- Emergency department patient flow
- Emergency vehicle location and routing
- Pharmacy inventory management
- Mass vaccination clinic design and scheduling



Current Research: Medical Decision Making

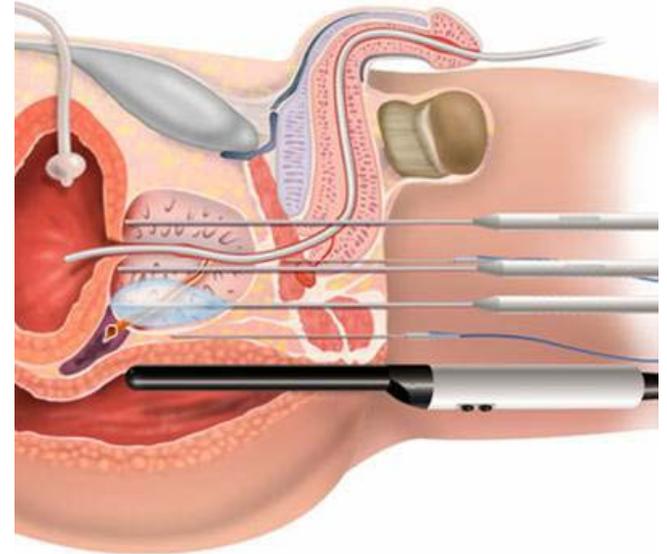
- Liver and Kidney transplant allocation
- Cancer screening policies
- HIV treatment
- Sepsis management
- Intensity modulated radiation therapy
- Diabetes treatment
- Vaccination policies



Cancer Therapy

Lee, E., Zaider, M. 2008, "Operation Research Advances Cancer Therapeutics", *Interfaces*, 38(1), 5-25

"Memorial Sloan-Kettering Cancer Center (MSKCC) seeks next generation cancer treatment advances.... Using operations research approaches, our team has devised sophisticated optimization modeling and computational techniques for real-time (intraoperative) treatment of prostate cancer"



Building and Infrastructure



Collaboration

- Health systems engineering must draw from many disciplines including:
 - Medicine
 - Health Services Research
 - Biostatistics
 - Bioinformatics
 - Health Economics
 - Administration



Societies

- There are many societies that foster communication among potential collaborators:
 - INFORMS Health Applications Society
 - IIE Society for Health Systems
 - POMS College of Healthcare Management
 - Society for Medical Decision Making

INFORMS Annual Meeting



MENU

- registration
- call for papers
- abstract submission
- interactive sessions
- committee & chairs
- program
- speaker information
- hotel/travel
- about san diego
- exhibits
- sponsors
- cist
- dm-si workshop
- colloquia
- job placement
- guest tours

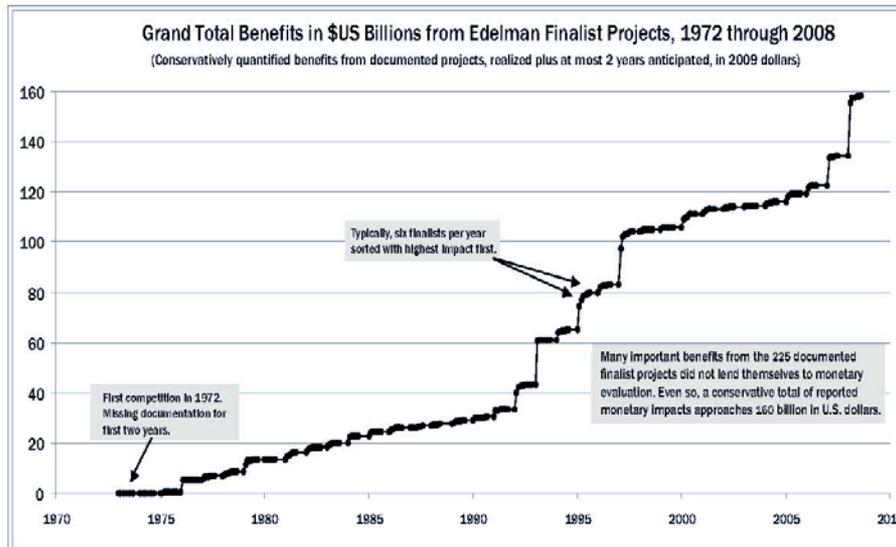


The INFORMS Annual Meeting 2009 San Diego will provide a forum to seek and explore opportunities for OR research in the diverse environment of San Diego, home of global industries emphasizing high technology, biotechnology, health care and tourism. We invite members of INFORMS and the worldwide ORMS community to join us in San Diego.

- [Interactive Sessions](#)- still accepting abstracts
- [Preliminary Program Schedule](#)
- [Guest Tours](#) - Balboa Park and San Diego Zoo
- Searchable program with abstracts online in August

Measuring the Benefits

- Develop success stories describing the translation of systems engineering into practical improvements in safety, access, cost, and effectiveness of health systems



Long Term Needs

- Funding opportunities (NSF, NIH, AHRQ) to encourage health systems engineering collaboration
- Journal outlets
- Academic programs
- Employment opportunities for graduates

Using Healthcare to Help Engineering

- Draw women, underrepresented minorities, and U.S. citizens into the engineering
- Develop new methodology that can be generalized to other application areas
- Raise awareness for systems engineering (or operations research, or management science, or whatever you want to call it 😊)



Questions?

