Operations Research: The Value Proposition

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Operations Research, co-founded by Philip M. Morse and other physicists in World War II, was designed as an **empirical science** using all relevant scientific methods to solve managerial decision problems.

In this brief talk we discuss quickly

- **STATE OF THE PROFESSION.** How INFORMS is emphasizing this aspect of Operations Research (OR), using observation, data and analysis to solve real and important problems. We provide examples of current ‘hot topics’ in OR research from many of the different segments of the profession.

- **MARKETING THE PROFESSION.** Efforts by INFORMS to tell others about the OR profession, now called “The Science of Better,” including OR’s implemented accomplishments and its importance in efficiently managing organizations.
Part I

Working on Real Problems
Culture and History

- Operations Research started as a named field in WWII, thanks to physicists such as Philip M. Morse

http://hcohl.shell42.com/morse.jpg
Quotes from

Methods of Operations Research,
Morse and Kimball

“Operations Research is a scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control.”

“Operations Research … is an applied science utilizing all known scientific techniques as tools in solving a specific problem.”

“Operations Research uses mathematics, but it is not a branch of mathematics.”

“… Operations Research is often an experimental science as well as an observational one.”

“It often occurs that the major contribution of the operations research worker is to decide what is the real problem.”
Most Major Advances in Operations Research Have Come from Work on Real Problems

- **A. K. Erlang**, Danish telephone engineer -- invented queueing theory in work aimed to determine optimal capacity of newly invented central telephone switching centers (1915)

http://www.polytechphotos.dk/pics/A.K_Erlang.jpg
Chinese Postman Problem


“When the author was plotting a diagram for a mailman’s route, he discovered the following problem: ‘A mailman has to cover his assigned segment before returning to the post office. The problem is to find the shortest walking distance for the mailman.’” (first sentence of this classic paper)

http://www16.big.or.jp/~nansya/ASCII-art/english/people/postman.gif

“…the work of wheat harvesting in the Peking suburbs was participated in by teachers and students…The objective …was experimental use of mathematical methods in the selection of the threshing site most economical of transportation.” (from first paragraph)

**Solved the ‘1-center problem’ on a tree (and more).**

The Hua Lo-Keng Prize in Mathematics is the highest honor in Chinese mathematical community. It was founded by Chinese Mathematical Society in 1992 to memorialize the great mathematician, the late Professor Hua Lo-Keng (1910-1985).
A Facility Location Problem


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Hua Lo-Keng

http://www.math.ac.cn/Chinese/B/Hualg/hua-stud.htm
OR Solves Real Problems!

• OR’s best theoretical work has been driven by real problems.
• We also mention
  – Linear programming
  – Dynamic programming
  – Markov decision processes
  – Search theory
Today, INFORMS Members Continue the Tradition of Working on Real Problems

• And INFORMS has expanded in both depth and breadth.
• Yes, we still do focused, traditional OR work.
• But, we also do so much more, as special sub-societies have spun out new INFORMS journals.
• Take a look........
Some Current Hot Topics*

- **From *Operations Research*:**
  - Homeland Security
  - Call centers
  - Internet modeling
  - Revenue management
  - Game-theoretic supply-chain management

*Thanks to Dr. Lawrence Wein, Editor-in-Chief of *Operations Research*
More Current Hot Topics*

• From *Mathematics of Operations Research*:
  - Internet modeling (heavy tail distributions)
  - Auction theory
  - Financial engineering
  - “Price of anarchy”

  • Aims at analyzing the difference between performance under "selfish behavior" and under coordinated optimization. The methods here are game theoretic, involving Nash equilibrium and competitive equilibrium. Methods of both discrete optimization and continuous optimization arise in the analysis.

*Thanks to Dr. Nimrod Megiddo, Editor-in-Chief of *Mathematics of Operations Research*
Even More Current Hot Topics*

*From Management Science:*

- **Social networks** (particularly as they relate to quantitative models of organizational structures).
- **Risk management** (e.g., use of finance and other tools to quantify and mitigate risk in a range of practical decisions beyond asset pricing and portfolio management)
- **Data mining** (the massive data bases becoming available via enterprise data warehouses and CRM systems ensure that the basic idea will remain of interest for quite some time).
- **Strategic planning** (much recent work has incorporated economic frameworks to consider competition and other high level market effects, but we still need research that brings these insights to the decision support level so that decision makers can use them in practical settings).
- **Service operations** (call centers and health care have been getting lots of attention in recent years, but with the growth of the service sector there are many other service industries where analysis could have a significant impact, such as primary/secondary education, retail sales, consulting, food service, etc.).

*Thanks to Dr. Wallace J. Hopp, Editor-in-Chief of Management Science*
Linda V. Green, Peter J. Kolesar
Improving Emergency Responsiveness with Management Science

Maurice D. Levi, Barrie R. Nault
Converting Technology to Mitigate Environmental Damage

Geoffrey A. Meester, Anuj Mehrotra, Jerald S. Ault, Edward K. Baker
Designing Marine Reserves for Fishery Management

Elena Katok, Alvin E. Roth

Kyle J. Mayer, Jack A. Nickerson, Hidea Owan
Are Supply and Plant Inspections Complements or Substitutes?
A Strategic and Operational Assessment of Inspection Practices in Biotechnology

Ananth V. Iyer, Apurva Jain
Modeling the Impact of Merging Capacity in Production-Inventory Systems

Stephen G. Powell, Kenneth L. Schultz
Throughput in Serial Lines with State-Dependent Behavior

Shawnee K. Vickery, Cornelia Droge, Theodore P. Stank, Thomas J. Goldsby, Robert E. Markland
The Performance Implications of Media Richness in a Business-to-Business Service Environment: Direct Versus Indirect Effects

Wagner A. Kamakura, Bruce S. Kossar, Michel Wedel
Identifying Innovators for the Cross-Selling of New Products

Pekka Korhonen, Mikko Syrjänen
Resource Allocation Based on Efficiency Analysis
Part 2
Marketing the Profession
Operations Research:

The world’s most important invisible profession!
Introducing The Science of Better

Champion's Kit site

Champion's Kit poster

 Prospect site
 www.scienceofbetter.org

E-marketing campaign poster

Executive Guide to O.R.

SEAT-OF-THE PANTS-LESS

EXPLAIN IT BETTER

PROVE THE VALUE

SELL IT BETTER

FIND RESOURCES

PROMOTING O.R.: THE SCIENCE OF BETTER

EXECUTIVE GUIDE TO OPERATIONS RESEARCH

OPERATIONS RESEARCH: THE SCIENCE OF BETTER

www.scienceofbetter.org
Campaign theme
Give creative expression to the

- A clear, authoritative tone
- Open-ended possibilities: theme lets audience participate and bring its own challenges to the Science of Better
Spread the Word, Far and Wide, to Young and Old!
The answer

The Franz Edelman Award

EXTREME MAKEOVER!

Edelman Award +

Advertising =

Success
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EXTREME MAKEOVER!

Edelman Award

Advertising

= Success
The Franz Edelman Award

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Edelman Award

+ Advertising

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Past finalists

- AT&T
- UPS
- Canadian Pacific Railway
- Merrill Lynch
- IBM
- General Motors
- Motorola
- HP
- NBC
- Ford
- Continental Airlines
- Samsung
- Peugeot Citroën
- BT
- U.S. Army
Many finalists have saved their organizations billions of dollars, realized huge gains in productivity, and made dramatic improvements in customer service.

- Continental Airlines won for their development of a decision support system to speed crew recovery of the airline in response to operation disruptions such as 9/11.
- IBM was a finalist for their development of an O.R. tool designed to integrate processes into a system that allows quantitative analysis of extended supply chains.
- Many finalists have saved their organizations billions of dollars, realized huge gains in productivity, and made dramatic improvements in customer service.
- GM won for overcoming costly factory bottlenecks that were slowing production and impeding product launches.
Past finalists

Other finalists have made a huge impact on our world

- The New Haven Health Department was a winner for their work to reduce the spread of AIDS through their needle exchange program.
Title: Workforce Flexibility Studies
Client: United States Postal Service
Contract Amount: $3,600,000
Key Words: Staffing and Scheduling, Optimization Modeling, Expert Testimony

Purpose: To provide technical support to the U.S. Postal Service (USPS) by identifying alternative workforce flexibility scenarios that could be part of labor negotiations with their largest employee unions.

Results: Using the developed workforce flexibility models, we were able to demonstrate clearly that as workforce flexibility increases, the cost of postal operations decreases and that returns begin to diminish at flexibility levels in the range of at least 30% to 40% for mail processing and 60% to 70% for retail and distribution. Based on our sworn testimony at an interest arbitration proceeding, the Postal Service was awarded a doubling of workforce flexibility from 10% to 20%.

Client Impact: According to the USPS, the annual savings from the arbitration award have been billions of dollars.
Ultimate Goals

• Build widespread awareness of Operations Research with business decision-makers

• Make the Operations Research profession relevant and essential

• Create pride in our membership
Winner who saved GM $1.6 billion

Procter & Gamble EVP

Finalists from the US Army, the World Bank, Continental Airlines, FedEx
We Welcome Your Ideas for the Event!

• Create a nice crystal “trophy” representing the award
• 5 minute video excerpts from each finalist
  – Played in between courses of the meal
• Keynote speaker
  – For example, a past Edelman winner talking about impact on organization
• Salute to past winners
• **Red Carpet** interviews!
Challenge: Give me a business problem area, and I’ll give you an OR Application

Thank You!
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