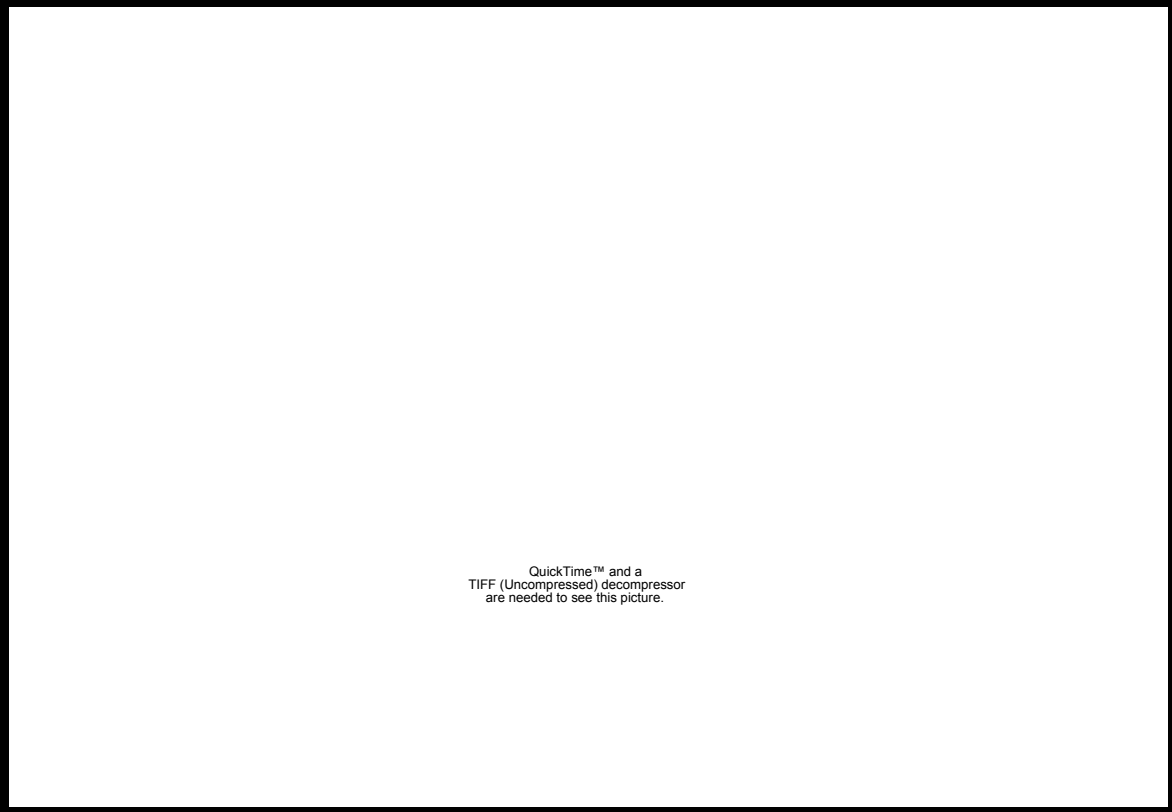
Operations Research: The Value Proposition

Boston, as seen from MIT



Hotel@MIT December 7, 2005

http://www.photo.net/photo/

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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

Mei-Ko Kwan ,Graphic Programming Using Odd or Even Points , *Chinese Mathematics,* 1:273-277, 1962.

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

"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

A Facility Location Problem

Hua Lo-Keng and others, **Application of Mathematical Methods to Wheat Harvesting**, *Chinese Mathematics* 2:77-91, 1962.

"…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).

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http://www.valleyviewcampus.org/Thresher.jpg


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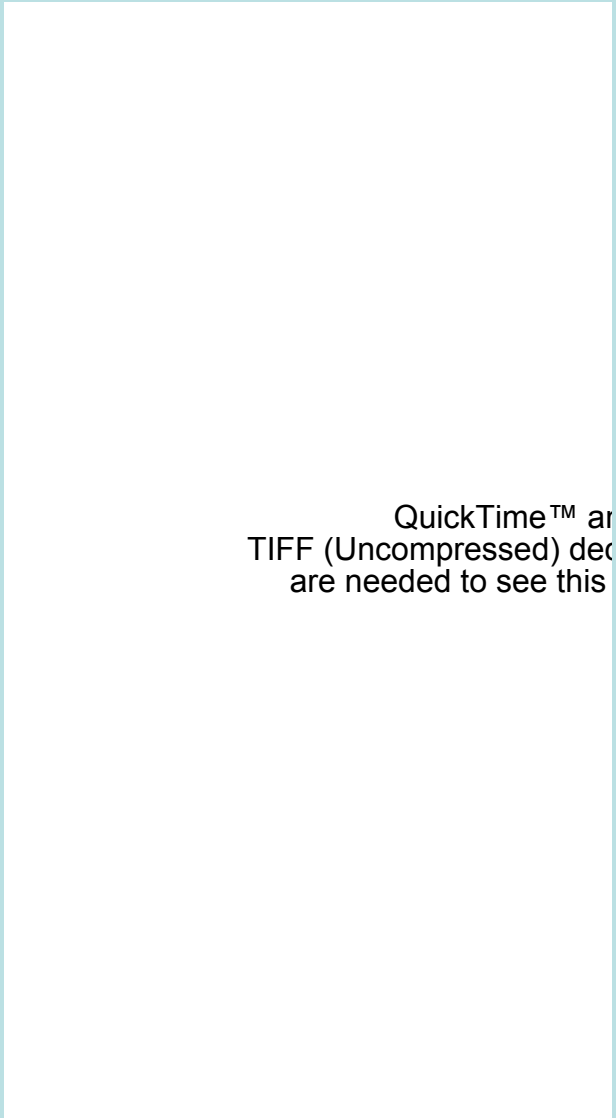

Hua Lo-Keng

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……

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Mathematics of Operations Research

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Marketing Science Journal

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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*

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- 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*

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http://mansci.pubs.informs.org

Part 2
Marketing the Profession

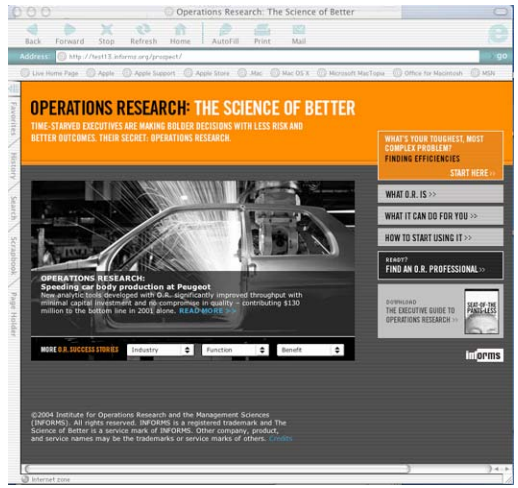
Operations Research:

The world's most important invisible profession!

Introducing **The Science of Better**

Champion's Kit site

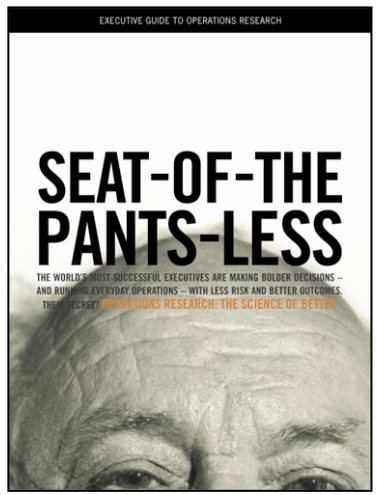
Champion's Kit poster



Prospect site

www.scienceofbetter.org

E-marketing campaign poster



Executive Guide to O.R.

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

The Franz Edelman Award

EXTREME MAKEOVER!

Edelman Award

+

Advertising

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Success

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Success

Past finalists

AT&T

UPS

Canadian Pacific Railway

Merrill Lynch

IBM

GM 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

GM General Motors

- 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 City Of
New Haven

- 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
Time Frame: November 1989 – April 1991; October 1997 – February 1999; July 2000 – September 2002
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
Finalists from the US Army, the World Bank, Continental Airlines, FedEx
Procter & Gamble EVP
informs

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!

Dick Larson

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