What is

Industrial Engineering and Operations Research?

IE & OR

Industrial Engineering deals with

- Development
- Improvement
- Implementation
- Evaluation ...

... of complex systems

- people, money,
- materials,
- equipment, energy,
- knowledge and information.

Operations Research is a discipline that

- applies advanced analytical methods
- in order to help make better decisions

What is it in "plain-speak"?

"Application of advanced ***analytical*** methods to help make better decisions."
`-http://www.informs.org`

"Engineers make things. Industrial Engineers make things ***better***."
`-http://www.iie.org`

"The application of scientific and especially mathematical methods to the study and analysis of problems involving ***complex*** systems."
-Merriam Webster

Applications: Few Edelman Prize Finalists

- CSAV, *Container logistics*
- Procter & Gamble, *Inventory optimization*
- Sasol, *Decision support*
- IBM, *Golf and Tennis forecasting*
- Syngenta, *Advanced analytics*
- LMI/Defense Logistics Agency, *Inventory control*
- Tata Steel, *Operations Managment*, **Winner**

`-https://www.informs.org`

History and Progress

- 18th - 19th century: Industrial applications
- 1909: First Industrial and Manufacturing Engineering department in Pennsylvania State University
- 1913: First assembly line
- 1940: Team of scientist in UK applied scientific techniques to research military operations thus the name "*Operations Research*"
- 1939-1945: Development of Operations Research during world war II

Popular IEOR Departments

- IEOR at University of California, Berkeley
- IEOR at Columbia University
- ORIE at Cornell University
- ORIE at the University of Texas
- Management Science and Engineering at Stanford
- IOE at the University of Michigan
- IEOR at University of Massachusetts
- ORC at MIT
- **IEOR@IITB**

Graph shows the phenomenal growth post world war II in terms of number of citations in IE & OR divided by total number of citations in all disciplines.

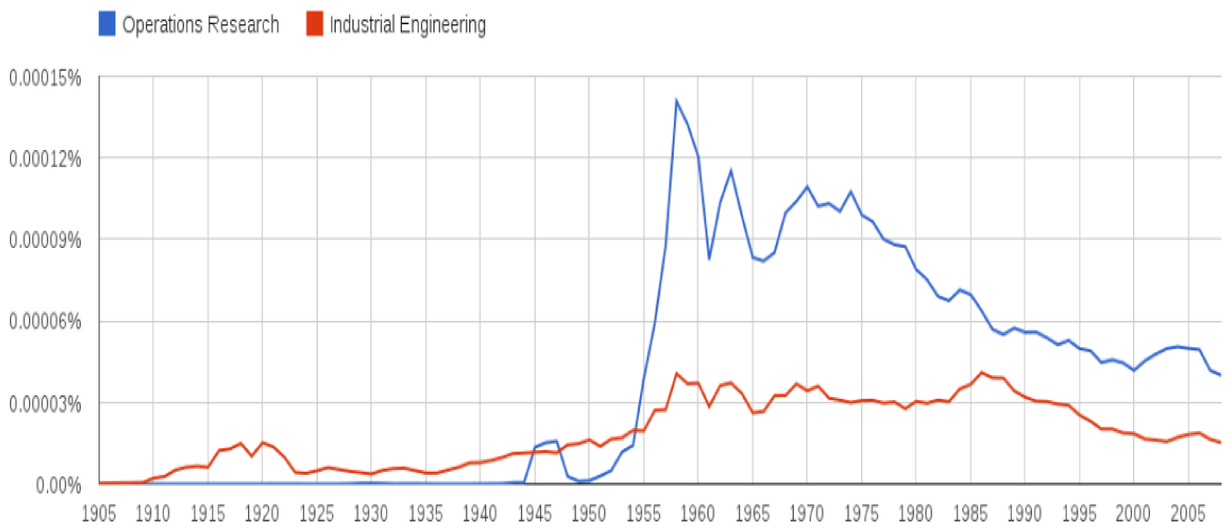

Figure 1: Growth of Industrial Engineering and Operations Research in 100 years

Top 10 Algorithms

1. Monte Carlo Method (1946)
2. Simplex Method (1947)
3. Krylov Subspace Method (1950)
4. Decompositions for Matrix Computations (1951)
5. Fortran Optimizing Compiler (1957)
6. QR Algorithm (1959-61)
7. Quicksort (1962)
8. Fast Fourier Transform (1965)
9. Integer Relation Detection (1977)
10. Fast Multipole Algorithm (1987)

`Source:SIAMNews,Vol33,No.4`

Everything is an Optimization Problem.
-Stephen P. Boyd

Main Tools of IE & OR

- Optimization
- Simulation
- Applied Probability
- Game Theory

Fundamental Topics

- Real Analysis
- Statistics
- Probability
- Algorithms
- Economics
- Combinatorics
- Graph Theory
- Linear Algebra
- Programming
- Data Structures

Application Areas

- Health care
- Supply chain
- Manufacturing System
- Transportation System
- Project Management
- Quality Management
- Waste Management
- Forecasting
- Revenue Management
- Business Analytics
- Economic Analysis
- Operations Management
- Financial Engineering
- Communication

Faculty Members and Current Research Interest

N. Hemachandra (Convenor)
- Stochastic Models, game theory, data driven approaches, Financial Engineering, SCM, power systems

P.G. Awate (Emeritus Fellow)
- Scheduling, Inventory Management, Neural Networks, Knowledge-based Systems

Veeraruna Kavitha
- Stochastic processes, Performance Analysis, Queuing Theory, Polling systems, Optimal control, Game theory

Ashutosh Mahajan
- Theory, Algorithms and Software for Mixed-Integer Linear and Nonlinear Optimization.

Vishnu Narayanan
- Integer Programming, Convex Optimization, and Polyhedral Theory

Narayan Rangaraj
- Optimization and Operations Research, Logistics and SCM, Railway Operations, Transportation

K.S. Mallikarjuna Rao
- Game theory, Stochastic Control, Probability, Partial Differential Equations, Viscosity Solutions

Jayendran Venkateswaran
- Modeling & Distributed Simulation (Discrete-event, System Dynamics), Integrated Supply Chain Analysis

Supply Chain Optimization Problems

- Vehicle routing problem
- Travelling salesman problem
- Job Shop Scheduling