

PROF. T. R. NATESAN ENDOWMENT LECTURE

***Opportunities for O.R. Professionals
in the internet era***

presented by

**Dr. P. Balasubramanian, Ph.D.
Founder & CEO, Theme Work Analytics, Bangalore
& Entrepreneur in Residence at Purdue University, USA**

at Anna University, Chennai, India on Feb 06 , 2008

balasubp@gmail.com

Birth of O.R. as a Discipline

- 1937 can be considered to be Base Year as this was the year the term Operational Research [O.R.] was coined.
- During WW II ,the Royal Coastal Command [RCC] of the British Armed Forces wished to protect the royal merchant ships in Atlantic ocean from being decimated by the German U Boats, to enhance the ability of royal air force to sight U Boats in time and to improve the effectiveness of patrol of coast with a given aircraft fleet size.
- RCC constituted a special team of Henry T. Tizard, Professor P.M.S.Blackett, and A.V. Hill.They were specialists in Chemistry, Physics and Anatomy respectively. They worked with many others in military operations with background in a variety of other disciplines.

Birth of O.R. as a Discipline

- Time was of essence here. Solutions had to be found quickly, often in days or weeks but not in months. Proposed solutions could not be simulated for verification of effectiveness yet any wrong solution could spell doom for the entire operation.
- Blackett and the team relied on available but limited data to study each of the stated problems and to give it a focus
- They were lateral thinkers who asked for painting the aircrafts white to reduce their visibility against a light sky
- They converted the coast patrol problem into one of effective maintenance of aircrafts.
- They suggested that the size of convoy of merchant ships be increased to minimize damage to them against enemy attacks.

Birth of O.R. as a Discipline

- The team was interdisciplinary in skills.
- It understood the time criticality of the problem and evolved timely solutions.
- It took an objective , data based approach for situation analysis, solution construct and evaluation of solution effectiveness.
- The researchers were capable modelers as they knew the concepts and their applicability.
- They were innovative.
- They had management support from start to end.
- Above all, they were tackling real world problems.

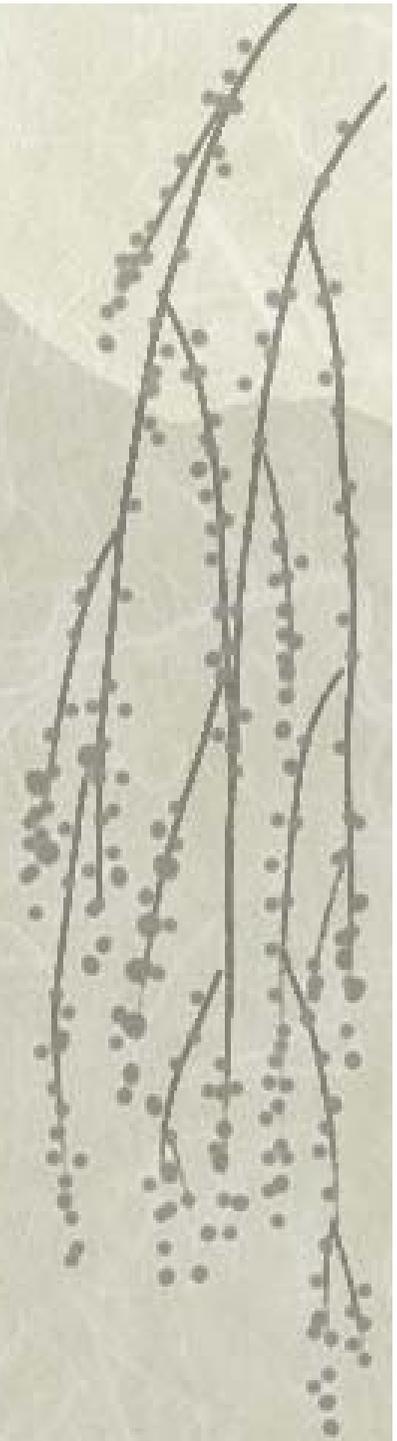
Should we ever wonder why they succeeded ?

Growth pangs of O.R.

- Considerable expansion and success in Industry and academia during the 50s and 60s.
- 96% of Fortune 500 companies had in-house O.R. groups in 1970
- but the numbers dwindled by the 1980s.
- Many practitioners of O.R. began questioning its utility, applicability and even its survivability within four decades of its existence.
- Ackoff fueled this debate in 1979 with an assertion that “The future of Operational Research is Past”.
- In 1997, Gass proposed that in many lines of business, issues pertaining to fundamental activities have been modeled and O.R. has saturated.

Growth pangs of O.R.

- Chamberlain's agony even in 2004 that O.R. faced the challenge of "to get the decision maker to pay attention to us" and to " get the practitioner and academics to talk to each other"
- And this debate seems to be in a continuous present tense.
- The fundamental issue has been the gap between developments on the theoretical front versus the application of O.R. models and concepts in practical circumstances.



challenges of the internet era

- Rapid Growth in affordable computing power

Can't we do an exhaustive enumeration in seconds ?

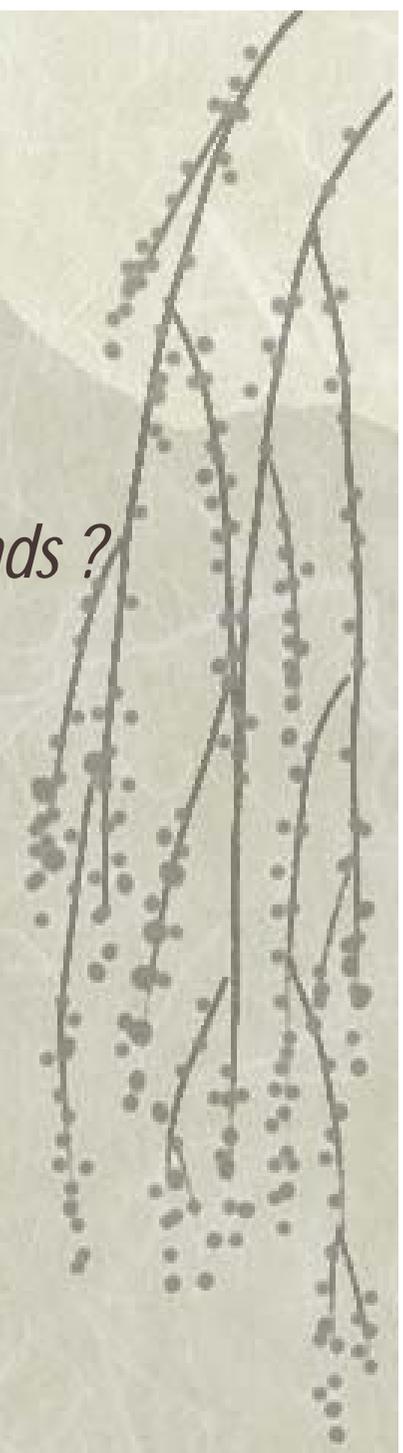
- Data Avalanche

Study the sample or population ?

- Internet Impact

Is it a segment of One ?

vanishing time intervals



Optimization Models : relevance and utility

- ❖ Traditional concepts: Use of inventory models to determine optimal lot sizes
- ❖ Contemporary thoughts: Inventory is evil and a liability. many components lose 0.5 % to 2.0 % of value per week in the high tech industry.
- ❖ **Hence Minimize it using JIT and TQM.**



Optimization Models : relevance and utility

- ❖ O.R. expertise needed to improve Forecasting Techniques earlier.
Forecasts were fundamental to many capacity planning and utilization decisions.
- ❖ With the ability to contact end user directly, firms have embraced mass customization methodologies and choose to count each order than forecast.
- ❖ **Minimal Forecasting is in.**



Optimization Models : relevance and utility

- ❖ Due to internet and exponential growth in networking, planning horizon has shrunk from quarters to days or even hours.
- ❖ Decisions that were considered strategic once have become operational now.
- ❖ The revenue management principle originated in the airline industry is a prime example. The allocation of seats to different price segments was strategic earlier. It is totally operational now and is embedded into the real time order processing systems.
- ❖ This practice has spread to many other service industries such as hospitality, cruise lines and rental cars.
- ❖ A beneficial side effect of ***strategic decisions becoming operational*** is the reduced need for assumptions and worrying about the constancy aspects of assumptions



challenges of the internet era ... the Information Age

- What is the relevance and utility of O.R. ?
- Will O.R. as a discipline survive in this digital economy?
- Will there be newer contexts in the emerging market place where O.R. would find relevance ?
- Does the discipline need to undergo a paradigm shift ?
- What is the future of O.R. practitioners?

Optimization Models : relevance and utility

- ❖ **Product Portfolio Optimization**
- ❖ Banks, Savings and Loan associations, insurance firms and mutual funds constitute the financial services sector.
- ❖ Customer segmentation, product structuring, pricing and credit worthiness assessment are issues tackled through sophisticated O.R. applications since the seventies in this sector.
- ❖ The concept of multi layering of risk and treating each layer as a distinct market segment is inherent to insurance and reinsurance lines of business. Product portfolio optimization for a given level of capital and risk appetite is mission critical
- ❖ Internet and online systems have enabled firms to gather product, customer segment and channel specific data on costs, margins and risks. Extending the product mix optimization applications from the manufacturing area to financial services is an exciting and emerging opportunity.
- ❖ Formulating cost effective programs to minimize identity thefts and fraudulent claims without alienating genuine customers are industry challenges where O.R. professionals can play significant enabler roles

Optimization Models : relevance and utility

❖ **Distribution Channel Design**

- ❖ Communicating with customers and potential customers on time and in a cost effective manner is the dream of every enterprise.
- ❖ internet and phone based customer reach /distribution channels have emerged, as customers seek to interact in multiple modes with an organization,
- ❖ optimal channel design in terms of segments, activities within a segment and balancing of direct versus indirect reach partners shall assume criticality. Channel cannibalization or channel conflicts are issues to contend with.
- ❖ Channels such as internet, kiosks and telephone have been around for a decade or more. However data on channel efficacy is either sparse or too macro. Over time a higher level of sophistication in channel usage will emerge as a key competitive edge.
- ❖ O.R. has enough tools and concepts to help out in such decisions for different segments in the financial services sector..

Optimization Models : relevance and utility

- ❖ **Trade off Issues**
- ❖ **Economic Development versus Ecology Preservation and Environment Protection**
(Kyoto protocol)
- ❖ **Penalties versus Incentives**
(tightening ship design standards to prevent oil spills)
- ❖ **Preventive Management versus Breakdown Management**
(the BPO sector safety issue of women employees)

(Avian Flu spread)

Innovative measures to monitor, test and isolate birds and fowls that move across national borders through legitimate trade, illegitimate routes and natural migration are needed in many countries. Formulating detection, prevention and treatment measures call for spending enormous sum judiciously. Cost effectiveness of each of these measures and their region wise efficacy need to be determined and alternatives chosen.

Optimization Models : relevance and utility

❖ **Issues of Fairness**

- ❖ Selecting employees for random drug tests.
- ❖ The issue of selection is entwined with concerns for protection of employee privacy, confidentiality as well as fairness.
- ❖ Post 9/11 similar situations have occurred in the airline industry with passengers being selected randomly for personal search.
- ❖ The alternative of covering the entire population is cost prohibitive.
- ❖ How does one be fair to all concerned and at the same time maximize the search effectiveness for a given budget? Or what is an optimal budget in such cases?
- ❖ Service Level Agreements for customer segments

Optimization Models : relevance and utility

❖ **Diversity Management**

- ❖ creation of means to handle variability. O.R. with its embedded statistical tools and optimization algorithms has enabled a better understanding of variability, at multiple levels (variance, skewness and kurtosis), its associated costs and has enabled meaningful and commercially viable market segmentation (as in the airlines industry)
- ❖ 21st century demands that we accept diversity as an integral and inevitable aspect of nature in every aspect of our endeavor. We as a society are expected to build systems, evolve policies and promote thoughts that accept diversity in totality.
- ❖ This can however be achieved only in an economic model that balances the associated costs with resultant benefits.
- ❖ O.R. is the only discipline that can quantify the diversity aspects anywhere and create the economic models to deal with the issues effectively. In that sense its longevity is assured

O.R. Emerging as the Analytics Team

Analytics Defined. It is..

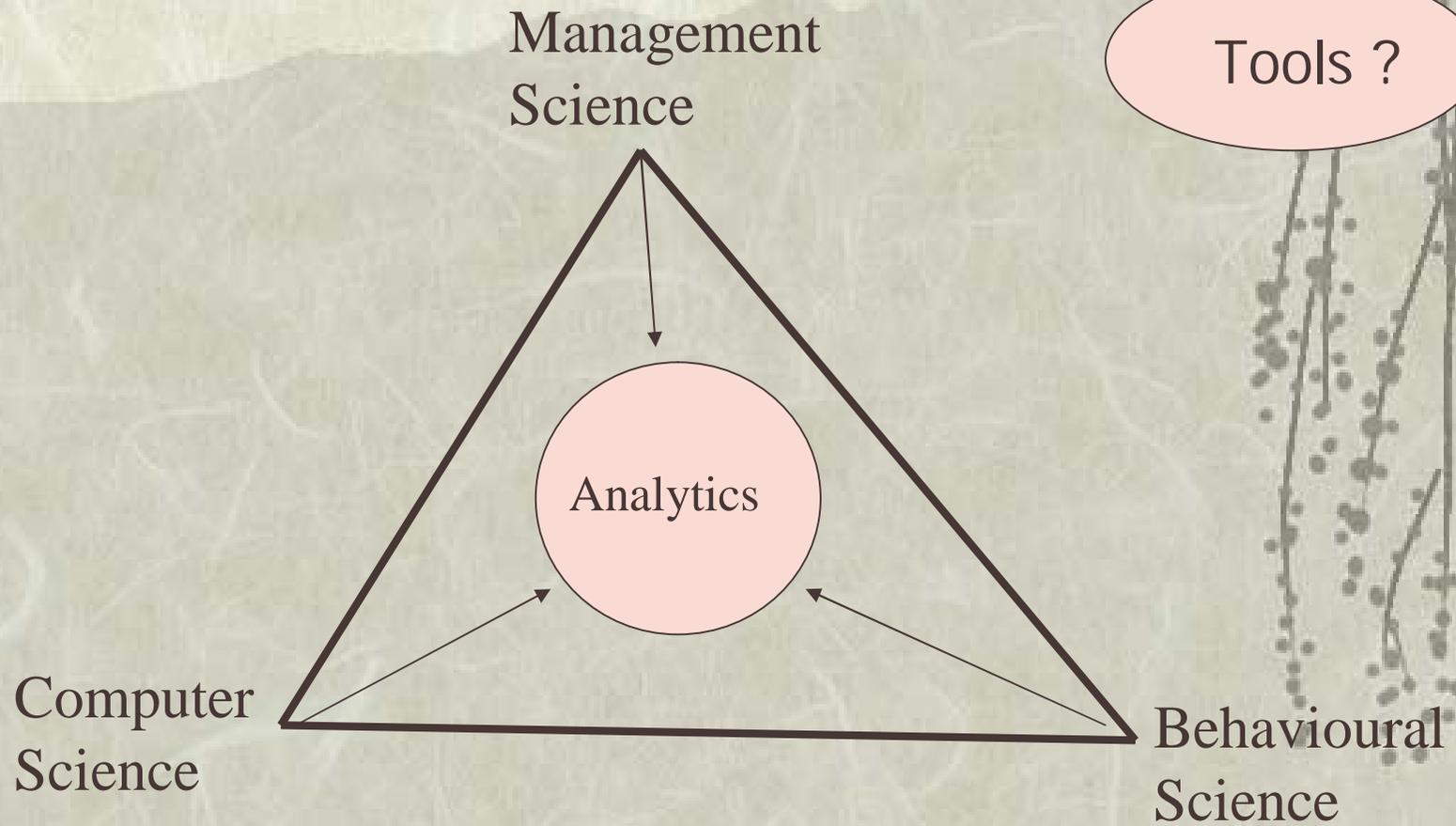
- Data Analysis
- Placing information in context
- About model building to simulate reality
- Assessment of alternatives to pick the best
- A knowledge (wisdom !) extraction means



Analytics

Its significant challenge lies in integrating inferences about interaction among inanimate objects and human behaviour : It is the best platform for dealing with diversity and tool for innovation

Leveraging Analytics ...



Leveraging Analytics ... Tools

Management Science

Statistical Analysis
Time Series
Modeling
Regression
System Dynamics
Optimization
Simulation

Computer Science

Data Base Technology
Expert Systems : AI
Data Warehousing
Data Mining
Pattern Recognition
Knowledge
Management

Behavioural Science

Motivation Theory
Group Behaviour
Learning modes

Bring diverse concepts together to innovate

Role of O.R. Professionals

- O.R. functionaries are housed in Corporate Planning, Production Planning & Scheduling, Management Information Systems [MIS] or Industrial Engineering [IE] departments or in an O.R. Cell. They tend to be in staff functions
- Direct responsibility to manage resources (machines, materials, money or workforce) rests with functional departments such as Production, Purchase, Finance and HRD. The onus to form an all inclusive stakeholder team rests with the O.R.
- Most organizations are goal driven. These are generally short term. The time horizon can be as short as a quarter and rarely extend beyond a year. The functional departments mirror this reality with monthly goals to meet.

Career Growth of the O.R. Professionals



- Their services are required at all times.
- Their role rarely raises above that of a middle or senior management position.
- There are no equivalent top management positions such as Chief Finance Officer [CFO], Chief Operations Officer [COO] and CEO for them. (Some with Information Technology [I.T.] skills can become Chief Information Officer [CIO]s).
- Diversifying their skill base (beyond quantitative) is a precondition for growth of any O.R. professional in most organizations.
- Acquisition of Analytics skills paves way for growth into functional areas.

References (partial list)

- Murphy, F.H., The Practice of Operations Research and the role of Practice and Practitioners in *INFORMS, Interfaces*, Vol 31(6), 98, Nov-Dec 2001
- Smith, B.C. et al , E- Commerce and Operations Research in Airline Planning, Marketing and Distribution , *Interfaces*, Vol 31 (2) ,37, Mar- Apr 2001
- Montgomery , A.L , Applying Quantitative marketing Techniques to the Internet, *Interfaces*, Vol 31 (2) ,90, Mar-Apr 2001
- Kapuscinski, R. et al , Inventory Decisions in Dell's Supply Chain, *Interfaces*, Vol 34(3) , 191, May-Jun 2004
- Geoffrion , A.M. and Krishnan, R, Prospects for Operations Research in the E- Business Era, *Interfaces*, Vol 31 (2) ,6, Mar-Apr 2001
- Gawande, K. and Bohara, A.K. , Agency problems in law enforcement: Theory and Applications to the U.S. Coast Guard , *Mgt.Science* , Vol 51 (11),1593, Nov 2005
- Butler,D.and Ruttiman,J., Avian Flu and the New World, *Nature*, Vol 441, 137, 11 May 2006
- Meyer,J.L.,Selecting employees for random drug tests at Union Pacific Railroad, *Interfaces* , Vol 27,(5) ,58, Sep_Oct 1997
- McCarthy, E.J., *Basic Marketing: A Managerial Approach*, Homewood, IL: Richard D Irwin Inc, 1960
- Thompson , D.V., Hamilton , R.W. and Rust, R.T. , Feature Fatigue: When product capabilities become too much of a good thing., *J Mktng Res.*, Vol XLII ,431, Nov 2005
- Ackoff ,R.L., The Future of Operational Research is Past, *J Opr.Res.Soc.*, Vol 30(2) ,93 ,1979
 - Gass , S.I., Model World :O.R. is the bridge to the 21st Century., *Interfaces*, Vol 27 (6), 65 ,Nov-Dec 1997
 - Chamberlain , R.G. , 20/30 Hindsight : What is O.R. ? , *Interfaces* , Vol 34 (2) , 123, Mar-Apr 2004

PROF. T. R. NATESAN ENDOWMENT LECTURE

Opportunities for O.R. Professionals in the internet era

Thanks and Best Wishes

February 05, 2008

Dr.P.Balasubramanian

Founder and C.E.O. ,

Theme Work Analytics,

Bangalore, India, 560 041

balasubp@gmail.com Ph : 91 80 4121 4297