

Research in Practice (RIP?) - the 2014 Beale Lecture

*“In theory there is no difference between theory and practice.
In practice there is”.*

Multiple attributions including Einstein and Yogi Berra

Robert Fildes, FORS

Dept. Management Science
Lancaster University

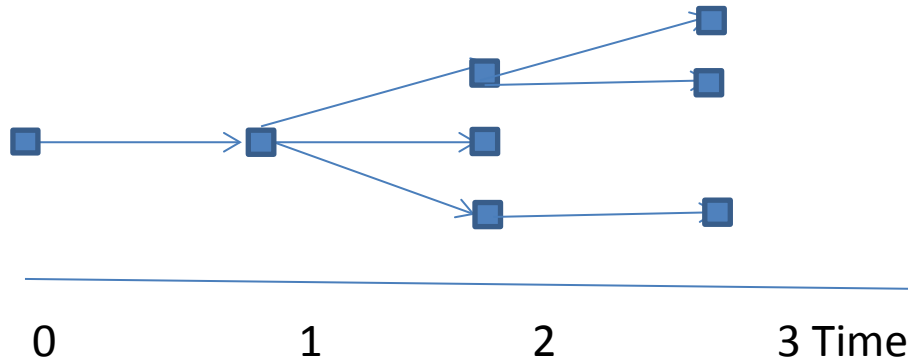
Abstract: Research in Practice

My early academic life was rooted in mathematics. But by a series of chances I found that practice whether it is in a field or an organisation differs substantially from what modellers typically study. This presentation will briefly examine the roots of OR and how it has developed with an increasing gap between theory and practice. But why is such a gap important for the profession? Working with John Ranyard and sponsored by the OR society in the 1990s and IFORS ten years later, we have investigated the state of OR in practice. The primary techniques and application areas of OR practitioners have changed little. However, OR and its boundaries are increasingly disputed and OR is yet again at risk of being side-lined in practice. The talk ends with a discussion of the role and responsibilities of the academy with particular reference to my specialist research area of business forecasting. Despite being a key applications area with its origins in operations organisations continue to use methods that have long been shown to be inefficient. The key is through improved 'knowledge exchange'. Taking an optimistic view, research focused on understanding the real problems organisations face, coupled with a training and development programme can help overcome the gap between theory and practice.

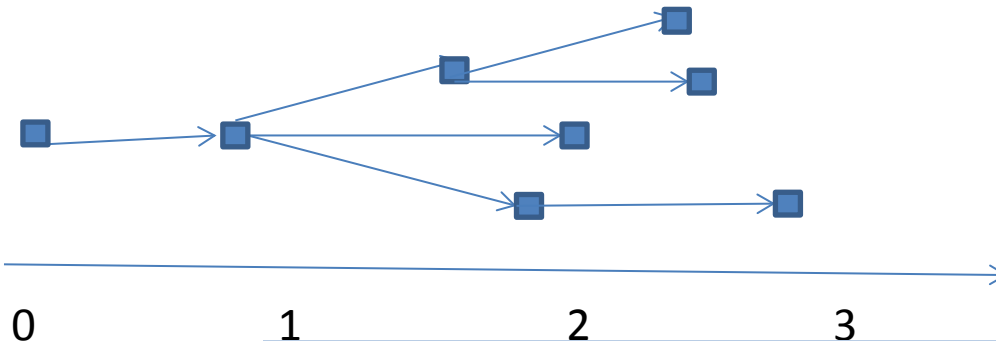
Agenda

- A personal introduction
- OR: its birth in practice
- Studying practice and why it is important
 - SSOR, Informs and IFORS
- The scope (methods) and organizational boundaries of OR
 - Analytics and Problem structuring methods
- The role of the journals
 - Effective Case studies
- Research in practice
 - Forecasting research and impact

Early 'Training'



- *Lots of mathematics*
 - *BA (Oxford)*
- *But? Industry or surfing?*



- *U. California (Stats)*
 - *Age-dependent branching process (birth & death process)*
 - *Course in statistical applications*
 - *Consulting*
- *Publications:*
 - *Crime: cluster analysis*
 - *Agriculture: probability model*
 - *Possible theoretical publications*

What to do in California after a Phd in maths?

- ***OR/ statistics***
- ***A Business School?***

Manchester Business School

- how I became a forecaster & what I learnt!



- Business Schools in the UK in 1971
 - Employed as ‘the statistician’: a specialist in a generalist school
 - An opportunity to learn ‘new’ things
- “I hope you’re managing to keep yourself employed”
 - A text book in forecasting (1976)
 - Self-taught
- Practice & entrepreneurial opportunity
 - Consulting & engagement

A key issue: how forecasters in practice must choose between alternative methods

The Gap!



What is OR!

Key features:

- A problem (or mess) and selected sub-components
- A (shadowy?) client
- An organizational context
- Decision objectives and constraints
- A structured approach to representing and manipulating these components

Scope and boundaries?

Issues

- Roots in the US and UK
 - Organizational vs academic OR
- OR's organizational hay-day: the 70s
- OR practice and the academy
 - Journals, conferences and masters students
- The decline in organizational internal OR
 - The Commission
 - “OR in practice will continue to be in-house”
 - CONDOR in the US
 - Success and Survival of OR (SSOR)

The developing debates – OR to 1995

- The Scope of OR
 - Ackoff's Messes, Eilon's Pragmatism and Checkland's Soft Systems

The scope of OR activities

- tactical or strategic?
- hard or soft(social science)?
- model or process?

- Mathematisation
 - Core skills and USPs

- Divergence between research and practice: the natural drift

- (Corbett and Van Wassenhove, 93; Abbott, 88)
- Organizational implications

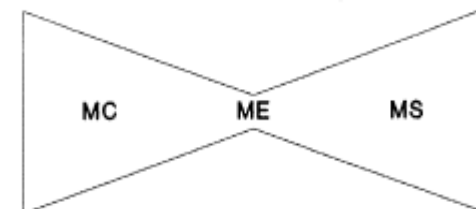
OR / MS
management consulting management engineering management science

ME

(a) | WWII – OR originated in ME

MC ME MS

50s, 60s expansion in consulting and 'academic' research, later squeezing ME



Organisational Change

The SSOR study: John Ranyard and RF commissioned by the OR Society

(Methods: Case studies + survey)

Background:

- Decline of internal OR groups
- Changes in the organisational environment

Aim:

- greater understanding of OR groups because of implications concerning Society activities.
- make the need to address the gap between researcher and practitioner

Dimensions

- Number, location, size, focus of internal OR groups
- Scope of projects
- Project management
- Expertise (training and recruitment)

SSOR and the Bowness Conference



Old faces in Bowness

Then

What followed from SSOR and the Bowness Conference (JORS, 1998?)

Conclusions:

- OR practice was changing from internal groups to external consultancies
 - Broadbased vs specialist
- USPs for OR
 - Problem solving vs techniques
- Recruitment problems
 - Decline of UK studentships (and students)
 - Technical focus of masters programmes
 - Requirement for consulting skills
- Management of internal OR groups problematic
- Various country studies: many similarities as to techniques and scope
- In 2009, IFORS sponsored study
 - 254 responses from 28 (out of 49) countries: > 60% from USA/UK

Focus:

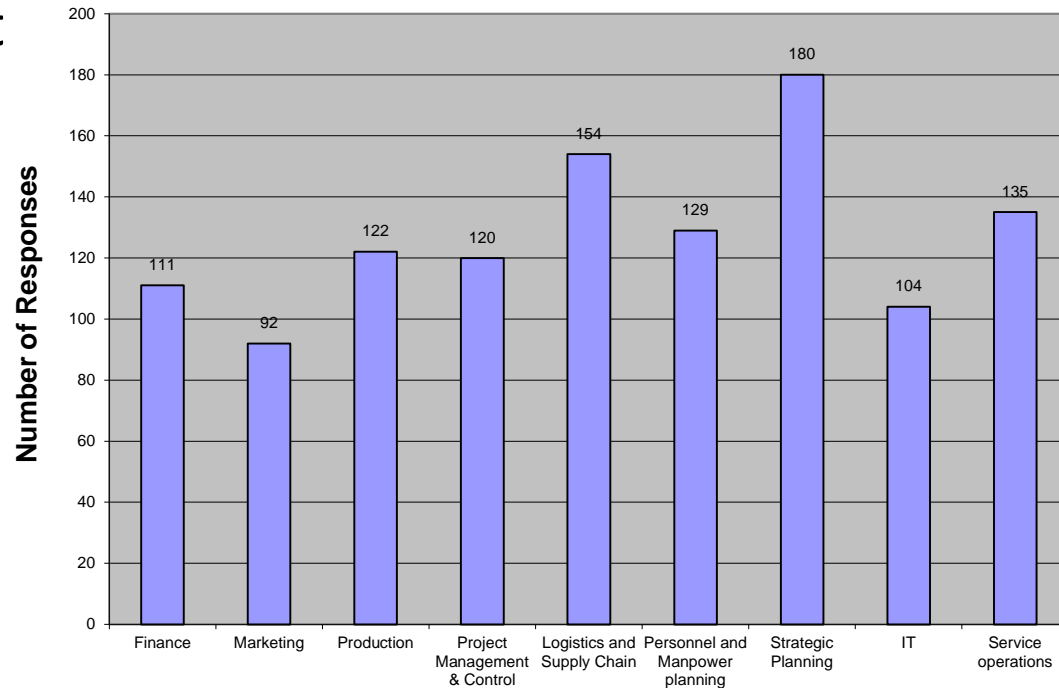
- Scope
- Modes of practice

Global Practice Survey

- the latest view of current OR practice

- Sponsored by IFORS, 2009/10
- 254 responses from 28 (out of 49) countries:
 - > 60% from USA/UK
 - Some significant omissions
 - Results ‘indicative’

Application area of your OR work



Global Survey - Types of OR Work

Analysis: factor analysis of regular or frequent use of techniques

- 3 clusters identified
- + respondents doing little OR:
- *Traditional OR workers:* more limited range of applications
 - Optimization, scheduling, simulation
- *Decision Support*
 - Problem Structuring Methods, risk analysis, system dynamics, and strategic planning
- *Business Analytics*
 - Statistics, data mining

Cluster	% using the tool set	% specialising in only this tool set
Traditional OR	38	46
Decision Support/PSM (facilitation)	31	34
Business Analytics	25	31
Low engagement	39	n.r.
Overall	61	36

The Scope of OR Practice – is it widening?

- Traditional OR well developed and successful
 - Logistics and supply chain applications
 - Not suited to ‘wicked’ & strategic problems?
- Problem Structuring Methods developed to extend the scope of OR
 - Strategic planning top applications area
- Business Analytics overlaps with OR and is rapidly expanding
 - But distinct differences both in focus and application
 - Marketing applications relatively low

But both areas are contested!

Problem Structuring Methods (Soft OR)

- Strategic Choice Analysis; Cognitive Mapping/SODA; Soft Systems Methodology
- Many successful applications to strategy & social planning problems reported but:
 - Slow growth
 - Mainly UK centred: health, social services....
 - Those working in strategic planning were the predominant users

		Didn't Use PSMs			Did Use PSMs			Total Respondents	
		Count	Row %	Col. %	Count	Row %	Col. %	Count	%
Respondents working in Strategic Planning?	Not working	60	89.6	39.6	7	10.4	7.4	67	27.3
	Working	91	51.1	60.3	87	48.9	92.6	178	72.7
	Totals	151			94			245*	

Barriers to the Use of PSMs

(Ackerman, EJOR, 2012)

- Require a facilitation role & different training compared to 'hard' OR
- Not accepted by many OR journals including key US journals
- Weakens the branding of OR
 - Not a USP
- 'Structuring' not 'solving', no unique answer
- **Contested** area:
 - Strategy/ OD consultants
 - No clear benefits compared to alternative approaches ('process change')

Analytics & OR – How Similar? I

(Liberatore and Luo, Interfaces, 2013; Mortenson et al., EJOR, 2015)

“Analytics, the scientific process of transforming data into insight for making better decisions” INFORMS

Analytics “as the discipline of making fact-based decisions using data, rigorous mathematical formalisms such as relational algebra (which underlies database technology), statistics, statistical modeling, machine learning, data mining, simulation, and optimization to evaluate choices and optimize business outcomes.”

Apte, Dietrich (Former INFORMS president) and Fleming (2012)

OR can have it both ways!

- *Retaining its USPs and conceding little ground to Analytics*

Analytics & OR – How Similar? II

- Analytics
 - Process centred (integrated into organisational structure)
 - Computer and data intensive
 - Management & exploitation of data
 - Statistics & data mining focused (INFORMS survey)
 - Powerful software available (vendors forceful)
 - Organizational location?
- OR
 - Consultancy oriented
 - Often data ‘light’
 - Rich & proven methodology...
 - ‘Decision Analytics’ = OR??

Does Analytics/Big Data need OR?

“Big data/analytics has rendered OR obsolete.”

- With big enough data, methodological matters such as
- assumptions of Normality and other distributional assumptions.....
- because with big enough data, the best answer is automatically obtained and optimal, with no need for those O.R. geeks or Math type people trying to turn practical business problems into "science projects".
- If we need a Math person, we'll evaluate them based on how much ..**Hadoop**, ...coding they have done, because nothing else matters (well, maybe except for **Java**).
- If any methodological aspects appear to still matter, it's only because we need even bigger data.”

Analytics and OR – Threats & Opportunities

- Analytics very popular and rapidly expanding relative to OR (Google stats)
- Overlap but distinct differences
 - Focus on continuing business processes??
- A single Masters course cannot cover both in required depth (some re-badging!)
- No existing professional representation
- Integration of OR and Analytics requires differences to be acknowledged & addressed (eg. credit & risk analysts)
- Where to position OR?
- How to promote the value of the OR Methodology?

The developing drift?

- *Development of OR less focussed in applications*
 - ✘ *Management Engineering still neglected*

Growth of degree programmes in analytics

- *Owned by IS*
- *Low contribution of OR modelling*
- *More stress on statistics/ computing*

The Gap – the role of the journals

- Categorisation of JORS articles (2014)
 - Based on Riesman and Kirchnick (Ops. Res, 1995) and Ormerod and Kiossis (Ops. Res, 94)
- Contentious dividing lines
 - Boundaries of OR
 - Novel Theory vs application
 - History+ philosophy, meta analysis, case
 - Type of data (synthetic, 'real', case)
- Evaluation: comparison with strong benchmarks

Theory vs applications

1962 1978 1994 2014

JORS

Meta Research +
philosophy/
history

57 60 35

Untested theory
True'

33 27 49 54

applications

10 13 16 46

Notes: 2014 JORS based on 6 issues; discrepancy in coding for 'Meta research/philosophy'

EJOR

Meta Research +
philosophy/
history

54 42

Untested theory
True'

42 55

applications

5 4

'Untested theory' still dominant

But what's an application?

What is an application?

Stylised application:

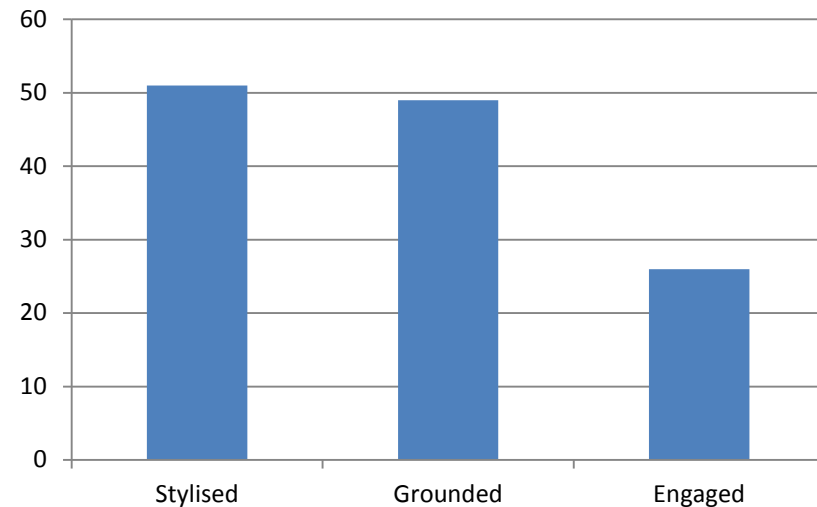
- Standardised context, e.g. machine shop
 - Possibly generalised
- Standard data set from external sources

Grounded application

- Real client/ real context of application
- sensitivity to assumptions

Engaged

- Real client & context
- Process issues
 - ✓ Data
 - ✓ Implementation
 - ✓ Policy sensitivity



Towards Richer Case Studies

Ormerod's 'mangle' (Pickering)

“To be of interest there needs to something new, knotty, substantial or interesting that arises from [implementation]”

It should:

- Describe the wider context
- Identify the roles of the author and other actors
- Describe the process and progress of the interventions
 - The actions of the actors
- Describe/ quantify the outcomes of the interventions

RF

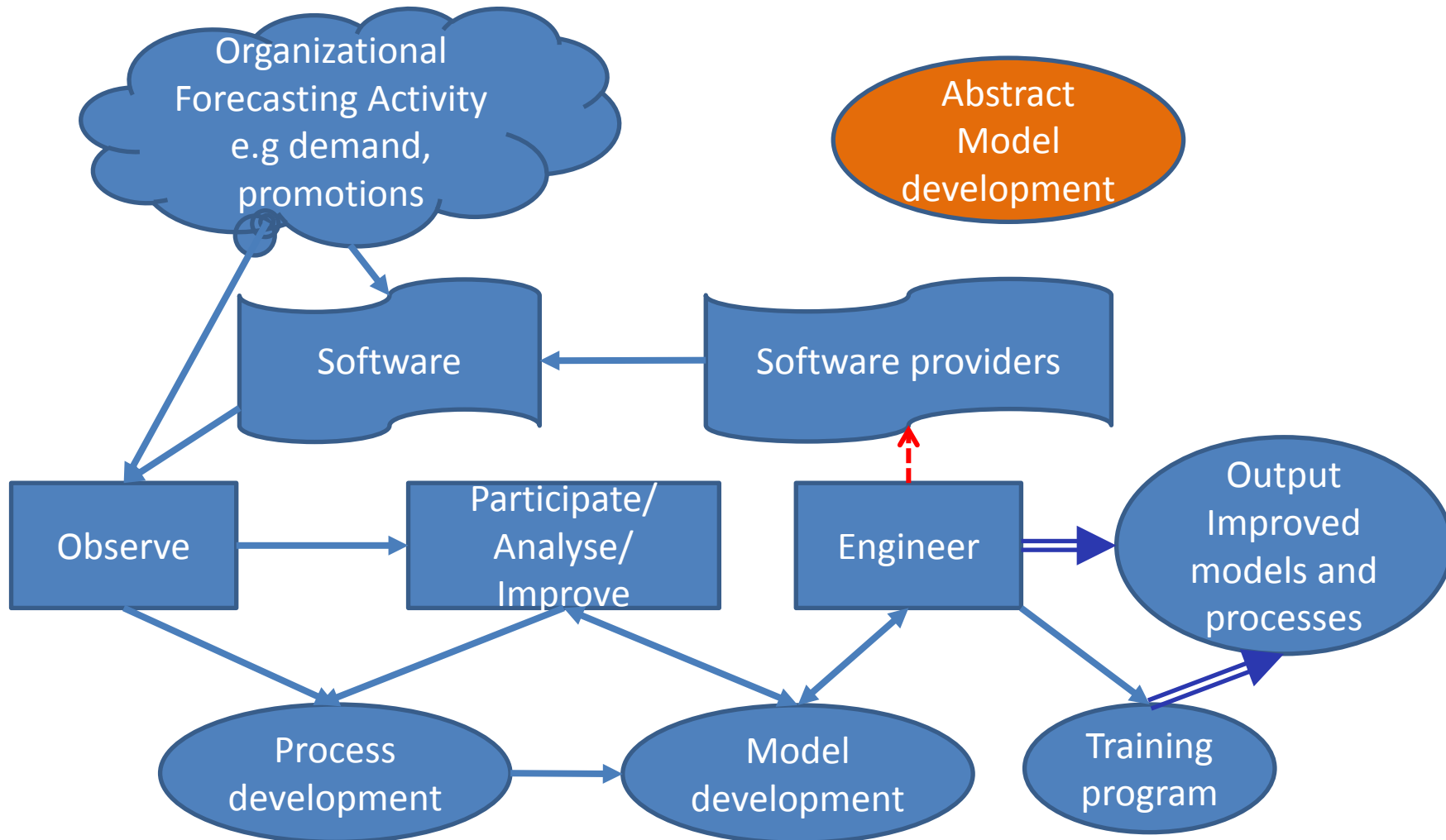
- Reflect on the implementation barriers

The argument so far

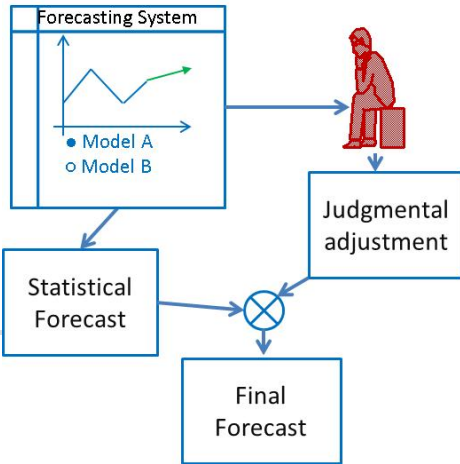
- OR's boundaries are fluctuating
 - Broadening but permeable(PSMs)
 - Contracting or threatened (Analytics)
- Skill sets differ across specialist areas
- The drift/ gap between practice and research is dangerous

- OR as a discipline needs to embrace its enhanced scope through its journals & conferences
 - And engage/ report on engineered solutions
 - ***Learning from practice***

- forecasting research at the Lancaster Centre



How are forecasts typically produced?



	Fildes & Goodwin 2007	Lancaster 2013 survey
i) Judgment alone	25%	15.6%
ii) Statistical methods exclusively	25%	28.7%
iii) An <u>average</u> of a statistical forecast and management judgmental forecast(s)	17%	18.5%
iv) A statistical forecast judgmentally <u>adjusted</u> by the company forecaster(s)	34%	37.1%

The revelation:

Judgment plays a key role in most forecasting processes

- *It is unanalysed*

Participate/ Analyse/ Improve

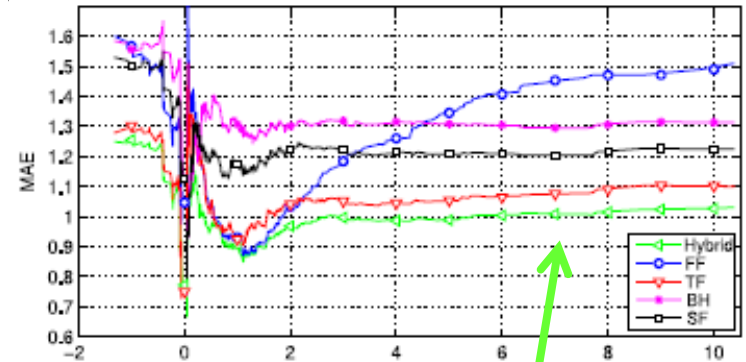
- Data collection
 - Actuals, statistical forecasts, final forecasts, available cues (e.g promotional events)
 - Process analysis: who does what with what and with whom
- Value added (SAS's terminology)
 - Does the forecast adjustment deliver accuracy improvements?
 - Is the statistical forecast 'optimal'
 - Based on off-line analysis using state of the art statistical software
 - Is cue information incorporated effectively?
 - Based on optimal models for including information

Engineer

- Re-calibration of existing systems
 - Important since SAP etc are dominant products
- Develop spreadsheet support
 - Most forecasting still done through spreadsheets
- Develop ‘advanced’ software
 - But.....
- Improve processes
 - Reliability and validation of data and input assumptions
 - Trained staff

Model development

- Inclusion of promotional information
 - Extended Kalman filter
 - Exponential smoothing like
 - Automatic
- Better performance vs company
- Judgment still adds value in major interventions
 - **Hybrid model incorporating promotional effects + judgment**
 - But how to develop software/ processes that capitalize on this information?



Size of judgmental adjustment

New forecasting knowledge and impact

- Heuristics and biases in judgmental forecasting (Fildes & Goodwin)
- Feasibility and benefits of automatic promotions modelling (Trapero, Kourentzes, Shaohui)
- Use and value of collaborative information (Crone, Boylan)
- Temporal hierarchical models (Kourentzes and Petropoulos)
- Software innovations
 - To guide and debias judgment, to interpret the information efficiently (Fildes & Goodwin)

Organizational improvements achieved through

- *MSc masters students (All)*
- *Training programmes to ensure sustainable innovations*



Bridging the gap

Critical to the survival of organizational OR

- Engaging with an extended scope to OR
 - Contesting/ complementing boundaries
- The journals and conferences
 - Role of practice
 - Need for ‘case’ material
 - Journal requirement for ‘applications’?
- Training, development and contract research programmes
 - To achieve impact

OR research without organisational clients will fragment and whither



Research in Practice – what have we learnt

- Organizational OR (and the external demand for OR) is under threat (again!)
 - The gap and drift
 - OR is now primarily a consulting activity
- The porous boundaries of OR into PSM and Analytics offer opportunities
 - But with educational demands because of their distinct natures
 - Both more embedded in organizational process
 - Organizational base of analytics a threat
- Observing current processes reveal new problems and new constraints requiring new solutions

Questions?

Acknowledgement: Thanks to John Ranyard, my colleagues in the Forecasting Centre and the Lancaster Department of Management Science