Improving forecast quality in practice

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Panel Discussion
Agenda

- The Forecasting Process
- Dimensions of quality
- How to go about auditing?
- Where are improvements likely to arise
  - Results of the survey
- Pointers
Demand Planning
Supply Planning
Reconciliation of plans

Finalise S&OP: link to implementation

Data Base

Statistical Forecast
Judgmental Forecast

Forecasting Process

Forecasting System

Model A
Model B

Monthly Process

Finance/Commercial

Reconciling ‘supply’ with demand

External Info & Market Intelligence

Demand Planner

Functional Forecast

Demand Planning
Supply Planning

Reconciliation of plans
The process (Sales and Operations Planning)

- Statistical forecast
- Information from sales, market research, planning, finance and logistics
- Incorporated into a final forecast from the forecasters back to interested parties
- Judgment is a key component
The S&OP process

Purpose:

- **integrating** the strategic, tactical and operations in matching supply and demand

- **KPIs**
  - Strategic, tactical and operational
    - Inventory investment
    - Service
    - Capacity utilization
    - Financial performance on budget
    - Forecasting accuracy
    - Sales target deviation

Service - inventory investment tradeoff curves
Alternative forecasting processes - for different organizations

• Automatic statistical forecasting

• Forecasting as advice
  – Only one ‘demand’ perspective (no reconciliation)
  – Model based or expert judgment

• Forecasting as trading
  – Rapid feedback on profitability

Focus on the Operational Demand/ sales forecasts and Information use:
(a reconciliation of demand and supply)
amongst Marketing, Sales, Logistics and finance
Usage of Forecasting Methods

Table V. Forecasting techniques ranked in order of frequency of use across forecasting horizon

<table>
<thead>
<tr>
<th>Technique</th>
<th>Short horizon ≤3 months</th>
<th>Mid horizon 4 months–2 years</th>
<th>Long horizon &gt;2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation</td>
<td>11</td>
<td>12</td>
<td>na</td>
</tr>
<tr>
<td>Life cycle analysis</td>
<td>12</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Decomposition</td>
<td>9</td>
<td>8</td>
<td>na</td>
</tr>
<tr>
<td>Box–Jenkins time series</td>
<td>10</td>
<td>8</td>
<td>na</td>
</tr>
<tr>
<td>Expert systems</td>
<td>nm</td>
<td>12</td>
<td>na</td>
</tr>
<tr>
<td>Neural networks</td>
<td>nm</td>
<td>8</td>
<td>na</td>
</tr>
</tbody>
</table>

Notes: M&C, Mentzer and Cox (1984), sample size = 160; M&K, Mentzer and Kahn (1995), sample size = 186; PS, present study, sample size = 86; nm, not measured in the study; na, not applicable (no respondents indicated use of the technique for that time horizon).

Key findings:

- judgmentally based methods more used than objective methods
- complex methods used less than simple methods
How are forecasts typically produced?

<table>
<thead>
<tr>
<th>Method</th>
<th>Fildes&amp;Goodwin 2007</th>
<th>This survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Judgment alone</td>
<td>25%</td>
<td>15.6%</td>
</tr>
<tr>
<td>ii) Statistical methods exclusively</td>
<td>25%</td>
<td>28.7%</td>
</tr>
<tr>
<td>iii) An average of a statistical forecast and management judgmental</td>
<td>17%</td>
<td>18.5%</td>
</tr>
<tr>
<td>forecast(s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv) A statistical forecast judgmentally adjusted by the company</td>
<td>34%</td>
<td>37.1%</td>
</tr>
<tr>
<td>forecaster(s)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Large sample results from the UK by Weller and Crone from 2011 confirm the results:

- Even in macroeconomic forecasting, judgment is added to a (complex) statistical model.
Steps in improving forecast quality

1. Auditing the current forecasting activities
   a. Purpose, horizon, information, value
   b. Evaluation: the accuracy record
   c. Benchmarks
      i. Against standard alternatives

2. Establishing the current forecasting process
   a. Who does what, with what resources?
   b. What information is available?
   c. Where do errors creep in?
      i. Other people’s information?
   d. Internal judgment calls

3. Areas for improvement
   1. Resources (people, software, data base)
   2. Techniques
   3. Information flows
Auditing performance – why?

• Need to know if current performance is good, bad or indifferent in order to decide priorities for improvement:
  – Where do errors get made?

• Measures need to be linked to the organization's performance objectives:
  – Standard KPIs may not make sense
  – Impact on organization

• Questions for any proposed performance measure:
  Does it help...
  – to identify why the problem occurred?
    • Is it over-reactive?
  – to correct or mitigate them (not find who to blame)?
Applying Benchmarking to Forecasting
Creating an improvement plan

• Goals, objectives
  – Horizon, level of aggregation (e.g. national, regional), updating, value of improved forecasting

• Scope and responsibilities
  – Sales, finance? Or just the analysts
  – Who carries the can?

• Resources
  – Software a given? Staffing? Data systems?

• Critical success factors
  – Areas of weaknesses in current performance
  – Organisational importance and credibility of forecasting

• Performance measures
  – Evaluation, how measured
Industry standards in forecasting

Dimensioning the Forecasting Process &
UNDERSTANDING YOUR OWN PROCESSES

*Based on a work carried out by John Mentzer & colleagues on 34 US companies*
*(Moon et al, Int. J. Forecasting, 2003)*

- **Functional integration in the Organisation (S&OP in supply chain)**
  - collaboration and co-operation between the forecasting team and other business functions
  - link with decision making/planning
  - Inter-organisational collaboration

- **Systems**
  - data base
  - software
  - support
  - feedback and organisational learning

- **Approach and methods**
  - problem specification, e.g. level of disaggregation, time horizon
  - techniques
  - evaluation and KPIs (accuracy)
Problems with an Organization’s Forecasting Process

- Data
- Data-user interface
- The Forecasting Support System
- Motivation & Training of Key Personnel
- Technical support
- Information flows (and linkages) from other departments and other organizations
- Lack of time (and resources)

Need for systems:
- accurate statistical methods
- easy-to-use
- easy-to-understand
- incorporate judgement
- incorporate drivers

**Forecasts are Frequently Politically Modified**
- In a US survey, 60% thought this damaged accuracy
“A good forecasting system leads to improved decisions”

What’s to be done? Improve!

- Functional integration and Information flows
  - the organisation of forecasting
- Forecasting resources and the information system
- Approach and Methods
Evaluating an organisational design

• Functional integration and Information flows
  – Information from the environment
  – intra-organisational flows and loss of information
  – Link to decisions

• Forecasting resources and the information system

• Approach and Methods
  – accuracy and bias
  – responsiveness and speed
  – uncertainty

✓ The information is not there
✓ Key environmental events missed
✓ Forecasts modified/ ignored

✗ Inefficient use of poorly designed system
  • Bias
  • Information lost

✗ Poor techniques are employed and we don’t understand how bad they are

No one responsible for data, forecasting & innovation
Auditing organisational and motivational issues

- Organisational Importance given to Forecasting: Score 5 (very important)
- Credibility Attached to Forecasts by Senior Managers: Score 4
- Importance in Planning: Score 4
- Priority given to Forecast Improvement by Top Management: Score 4
- Integration across functional areas: Score 3
Improving forecasting – as was

<table>
<thead>
<tr>
<th>Activity</th>
<th>Respondents Scoring Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing consistent data</td>
<td>83%</td>
</tr>
<tr>
<td>Increased software support</td>
<td>70%</td>
</tr>
<tr>
<td>Improved techniques</td>
<td>66%</td>
</tr>
<tr>
<td>Improved data bases</td>
<td>61%</td>
</tr>
<tr>
<td>Improved communication with users</td>
<td>35%</td>
</tr>
</tbody>
</table>

How have things changed?
Potential problem areas that get in the way of improving the quality of business forecasting.

- Organization/Information
- Systems
- Resources
- Techniques
- Evaluation

Sample size: 47
Principal objective:
Production of accurate forecasts, given the available resources

Other objectives: Timeliness, Stock availability, Stability of forecasts, ...

And are forecasters satisfied with their accuracy?
Organisation/Information
(Modes and Means: □)

- Availability of internal data
- Availability of external data (e.g. sector growth, retail sales)
- Motivation to produce better quality forecasts
- Quality of forecasts received from other parts of the organisation
- Support from senior managers
- Interventions and changes to the forecasts by senior managers
- Misaligned objectives between sales and demand planning
- Quality of forecasts received from other organisations

Not at all important | Of little importance | Of some importance | Important | Very important
**Systems**

- Availability and accessibility of an integrated database
- Quality of forecasting software available to use (where forecasts are not Excel based)
- Over-reliance of Excel in producing our forecasts

**Resources**

- Lack of training in the forecasting team
- Volume of forecasts need to dealt with
- Quality of technical support to overcome problems
Techniques

Limitations of the statistical models

Quality of judgmental interventions made by the forecasting team

Evaluation

Measuring the accuracy/value of the forecasting activity
Other: Purchasing / Supply, Planning and Control (Logistics), Revenue Growth Management
Means of collaboration

**Internal**
- E-mail: 89.4%
- Meeting: 78.7%
- Conference call: 44.7%
- Dedicated software: 36.2%
- Conference: 19.1%
- Other: 12.8%
- Not relevant: 2.1%

**External**
- E-mail: 76.6%
- Conference call: 34%
- Meeting: 31.9%
- Dedicated software: 17%
- Conference: 17%
- Other: 8.5%
- Not relevant: 21.3%
Intra and Inter-organizational Data Sharing

- Alternative approaches have different capacities for sharing info

**Internal data** much more commonly used than external

- Contrast ‘silos’ with SOP

Alternative approaches to information sharing

CPFR: Collaborative planning, forecasting and replenishment
SOP+info: S&OP process with inter-company sharing
SILOS: limited interfunctional information sharing
Is our approach comparable to ‘best’ practice?

• Benchmarks compared to other companies?

<table>
<thead>
<tr>
<th>Aggregation</th>
<th>1M</th>
<th>2M</th>
<th>3M</th>
<th>12M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>33.10</td>
<td>32.81</td>
<td>35.57</td>
<td>38.57</td>
</tr>
<tr>
<td>Item</td>
<td>40.21</td>
<td>38.56</td>
<td>40.74</td>
<td>44.81</td>
</tr>
<tr>
<td>Customer</td>
<td>39.11</td>
<td>39.11</td>
<td>41.92</td>
<td>43.35</td>
</tr>
</tbody>
</table>

• Well yes, it can be done, but what do the results mean?

• Problems with survey evidence
  – Samples are biased
  – Lack of clear meaning from accuracy questions
  – Small numbers relevant to any particular organization

*Organizations face Unique forecasting problems
E.g. customer specific behaviour*
Auditing ‘accuracy’

- note that service levels etc also need auditing

The questions to ask – an example?

- Match between forecasts and decisions?
  - Cross-section hierarchy: sufficient ‘sku’ detail?

- Performance measures
  - MAPE too easily distorted
    - Leading to false conclusions on benefits from new methods/value added

- Input assumptions or forecasts?
  - Is it your forecasts that are inaccurate or the input assumptions?
**Benchmarking an organization’s forecasts**

- **Sample of time series**
  - Actuals
  - Statistical forecasts + judgmental adjustments

- **Competitive methods**
  - In an ideal world
  - In the real world as is

- **Agreed accuracy measures**
  Davydenko and Fildes, Int.J.Forecasting
  - Out-of sample rolling origin
The technical evaluation – an example

• Forecast the regional requirement for engineer hours
  – Input forecast: UK bookings of work
  – Assumptions: regional percentages, travel times, job times

Delivering required forecast
Using linear regression and judgment

• Regional time series histories

• Evaluate: input forecast vs actual assumptions, value added from judgment

• Alternative methods
  – Hierarchical approaches
  – Extended range of univariate methods
  – Improved forecasts of inputs and assumptions
Why don’t we adopt better forecasting processes?
Barriers to adopting new procedures

• Compatibility with existing practices
• Divisibility
• Communicability and complexity
• Riskiness
• Managerial factors + value of new procedure
  – Top-management
  – User-designer relationship
  – Implementation strategy
  – Environmental events
Improved forecasting is achieved by:

• Improved information flows

• Using new techniques and processes
  – with the associated software

• Support systems to encourage effective inclusion of judgment

• Effective organisational links

• Trained, motivated and better resources managers

✓ forecasters with too much to do produce worse forecasts!
BSkyB Operations - an Improvement Programme

Components:

• 14 forecasters reporting to the supply chain director

The Program

• Forecasting Process analysis based on Interview (trainers + BSkyB)
  – Identified skills, problem areas, software, data
• ‘Fundamentals’ 2 + 2 day course
  – Purpose of forecasting, Time series data analysis, Exponential smoothing (using Excel), Evaluation,
  – Regression, judgment, improving forecasting
• Comparative forecasting analysis (trainers)
• Project from BSkyB to codify and evaluate their approaches

IIF Certification

– On-line tests + project

Process and Resource (software) recommendations
Takeaways – on improving the Quality of Organizational Forecasting

• Specify forecasting problem
  – level of aggregation & Forecast horizon
  – Available information

• Data base
  – IS and common accessible data base

• Current accuracy
  – Compared to base line method on your data
    • Exponential smoothing, Naïve
  – Appropriate measures?
  – Value-added analysis of judgment?

• Software choices
  – Benchmarked statistical methods

• Implementation and Improvement Issues

• No match with decision problem
• Key information lost

• Or is unavailable in practice

• Audit offers guidance on the potential benefits

• Poor software, badly implemented is costly

• A development program can identify and deliver on the weaknesses
Panel discussion and questions, comments?
Speakers: Robert Fildes, Fotios Petropoulos

The question:

What is your priority area for gaining improvements in an organization’s forecasting?

Chair: Len Tashman
Panel:

Scott Armstrong, Stephan Kolassa, Eric Stellwagen