Forecasting

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1. Introduction

Despite the fact that it is impossible to predict future development with total accuracy, forecasting has been an important concept within business (Davis, 1993).

Identifying the purpose of the forecast is important to determine the accuracy level required and the resources needed to obtain it (Lysons and Farrington, 2016). When forecasting is used to predict demand, it requires understanding of demand patterns and the way factors such as product life cycles, competition, and changing market dynamics impact on these patterns (Boyer and Verma, 2010; Lysons and Farrington, 2016). In the supply chain, forecasting can help to deal with the 'bullwhip effect' caused by the distorted flows of information up and down the supply chain. Excessive inventory quantities, poor customer service, cash flow problems, stockouts, high material costs, overtime expenses and transport costs, which cause the 'bullwhip effect' can be avoided by accurate forecasting (Handfield and Nichols, 2002; Monczka et al., 2009; Porasmaa and Ojala, 2011).

Forecasting also requires establishing a time horizon, as it is difficult to be as accurate the further into the future they go and are not applicable to some products (Lysons and Farrington, 2016). For example, different aspects of technological products with short life cycles can only be forecasted a few months into the future. At the same time, demand, stock, price, cost and other applicable to furniture product forecasting can be done for years ahead, since furniture products have a longer life cycle (Boyer and Verma, 2010).

Forecasting largely depends on a free and plentiful flow of information (CIPS: Demand planning). It can be achieved using quantitative or qualitative techniques and can be based on different types of data requiring different analysis methods. Results can be presented in a number of different forms but generally include a report summarising the purpose, assumption, techniques and conclusions. The degree of forecast accuracy should be monitored and its assumptions, techniques and validity of data revisited when the actual outcomes differ considerably from those predicted (Lysons and Farrington, 2016).

2. Definition

Forecasting methods encompass techniques employed to systematically analyse data and information in an attempt to predict future patterns, trends or performance (Lysons and Farrington, 2016).

3. Successful Application

In a Harvard Business Review paper (Saffo, 2007) suggests five rules of effective forecasting: "define a cone of uncertainty" by delineating possibilities that extend out from a particular moment or event; "look for the S curve", guided by the notion that change rarely unfolds in a straight line and important developments typically follow the S-curve shape of a power law; 'embrace the things that don't fit', since the best way for forecasters to spot an emerging S curve is to "become attuned to things that don't fit, things people can't classify or will even reject"; 'hold strong opinions weakly' to avoid a mistake of over-relying on one piece of seemingly strong information; 'look back twice as far as you look forward', as the pattern of past events can be used to connect the dots of present indicators and plot a map of future trajectory; 'know when not to make a forecast" because generally more elements do not change than new things that emerge.

4. Steps to Successful Application

- For time series modelling, select the type of model to be used. Common models for representing the dependence of time series are the Markov chain and the autoregressive model.

- Identify the form or the order of the model.
- Estimate the model's parameters and undertake some checks on the conditions to be met by these parameters.
- Run a diagnostic check of the model to assess how good the model is (e.g. goodness of fit).

Salas et al. (1997)

5. Hints and Tips

- The most effective way to mitigate or prevent the bullwhip effect is to ensure high levels of transparency and information sharing through the supply chain. Also, direct demand data is generally preferable to an overreliance on forecasting (Lysons and Farrington, 2016).
- For demand and future requirement forecasting, an effective inventory control system should not be implemented without first analysing records of usage and demand trends for a given stock item over a period of time (CIPS: Demand planning).
- An important issue in forecasting is choosing the most appropriate techniques. Examples of qualitative techniques include expert opinion, market surveys and Delphi method. Quantitative approaches include time series modelling and rely on 'hard' information that eliminates most personal bias attributed to qualitative techniques (Lysons and Farrington, 2016).
- The Delphi method, a combined qualitative and quantitative technique, is a useful forecasting technique when there is no historical information on which to base more objective forecasts is available (Lysons and Farrington, 2016).
- When using time series modelling, it is important to remember that it is an iterative process with feedback and interaction occurring between each of the relevant stages (Salas et al., 1997).

6. Potential Advantages

- Forecasting is an important component of organisational and business activities. Companies regularly make predictions about future circumstances and scenarios based on information available to them (Escanciano, 2005; Harvey, 1989).
- Employing appropriate forecasting methodologies can reassure stakeholders that decisions are being based on the best information that is available at the time (Lysons and Farrington, 2016).
- Forecasts can be divided into long-term, medium-term and short-term time horizons to better understand the degree of accuracy that can be obtained and the potential risks associated with longer horizons (Lysons and Farrington, 2016).

7. Potential Disadvantages

- Forecasts are subject to the 'bullwhip effect': this is the uncertainty generated by information flowing up and down the supply chain (Lysons and Farrington, 2016).
- A variety of unforeseen events and circumstances can impact predictions, for example economic and social factors, or natural and environmental disasters (Lysons and Farrington, 2016).

- Predictions based solely on qualitative forecasting techniques may be subject to criticism as they are based on 'soft' information, even in circumstances where collecting more objective, time-series data is unfeasible because of resource constraints (Lysons and Farrington, 2016).

8. Performance Monitoring

- Goodness-of-fit tests: can be used for both linear and non-linear time series models (Escanciano, 2005).
- Anderson test of the correlogram/Porte Manteau lack of fit tests: can be applied to test the independence of a time series (Salas et al., 1997).
- Chi-square/skewness tests of normality: basic tests of normality for time series data (Salas et al., 1997).

9. Case Studies

- Swift and Co., an abattoir and processing company in the US, uses advanced scheduling and capable-to-promise (CTP) solutions to effectively manage the customer side of its supply chain. These solutions provided a 200% ROI in their first year (Bixby et al., 2006).
- Masco Corporation, with annual sales exceeding US$13b, announced plans to cut 8,000 jobs in 2007 because of forecasting based on time series modelling which revealed employing such a large workforce going forward into the future would be detrimental to its competitive advantage in the increasingly tight market (Boyer and Verma, 2010).
- Intel developed production facility capacity models along the semiconductor supply chain in collaboration with key suppliers. Access to these models (in strict confidence) allows Intel to better handle bottlenecks resulting in considerable annual savings, while suppliers benefit from more accurate forecasts (Shirodkar and Kempf, 2006).
- Research:
  - Procurement teams would need to move away from producing one yearly forecast of input prices for their internal marketing teams who set output prices. Instead they would need to develop scenario planning to help marketing set future prices as costs become more volatile. This means they would need to present ongoing forecasts and help work on scenarios to cope with prices going up and down. Procurement and marketing teams are now sharing more data and working more closely to ensure companies' prices can cope with changing input costs, Sullivan said. "They have recognised annual processes do not work so effectively. Procurement teams provided the outlook for the costs, but they have moved away from that, realising they cannot forecast. Instead they are asked to develop a number of scenarios."

10. Further Reading/Reference

CIPS Source Downloads

- CIPS: Beyond project management. A professional guide to planning and managing complex ICTPFIP
- CIPS: Demand planning

Web Resources

- Country-level forecasting problems.
  https://www.cips.org/en-gb/supply-management/news/2005/january/uk-executives-struggle-with-demand-forecasting/
- Brief overview of demand forecasting methods.
  https://www.scribd.com/document/62810048/SME-Toolkit-Demand-Forecasting
- E-commerce and demand forecasting.
  https://www.cips.org/en-gb/supply-management/news/2010/september/e-commerce-now-a-boon-for-demand-forecasting/
- General overview and examples of forecasting methods.
  http://people.brunel.ac.uk/~mastjjb/jeb/or/forecast.html
- Introduction to statistical forecasting.
  http://www.statisticalforecasting.com/

Books

- Purchasing and Supply Chain Management, Dr Kenneth Lysons & Dr Brian Farrington, ISBN 978-0273694380
- Operations and Supply Chain Management for the 21st Century, Boyer, ISBN 978-0618749331.
- Designing and managing the Supply Chain, Simchi-Levi, ISBN 978-0072492562.
- Principals of Supply Chain Management, Joel D. Wisner, Keah-Choon Tan & G Keong Leong, ISBN 978-0324657913.
- Supply Chain Management, Janat Shah ISBN 978-8131715178

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- Salas, J.D., Delleur, J.W., Yevjevich, V. and Lane, W.L. (1997) Applied Modelling of Hydrologic Time Series. Water Resources Publications: Colorado, US.
- Shirodkar, S. and Kempf, K. (2006) Supply Chain Collaboration Through Shared Capacity Models. Interfaces, Vol. 36(5), pp. 420-432.

Video

The importance of demand planning and forecasting.

https://www.youtube.com/watch?v=H0HBlGwcEQk&feature=player_embedded