Technology & Management Perspectives

Management techniques and practices to promote competitive advantage

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Forecasting:

Why *some* managers outperform statisticians at forecasting

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Abstract

Accurate forecasting is important to business success. This paper[1] describes an effective way of integrating managment judgement into statistical forecasts to improve forecasting accuracy.

The art—or science—of forecasting has obsessed mankind for aeons. The legendary Sun Tzu noted the importance of 'foreknowledge' in his manifesto on warfare written in the 4th century BC and aptly titled, *The Art of War.* Over the years crystal ball gazing has found a role in anything ranging from warfare to astronomy and science, and more recently to economics and other social sciences.

Business planning is, by its very nature, concerned with the future. Forecasting is essential to all business planning. How could companies determine their cash requirements for the following year if they could not predict, or at the very least 'take a view' of, what their expenses and sales would be in that year? While many senior executives claim that forecasting with any degree of accuracy is impossible—and in many cases it is—those same executives will congregate around a board room table and discuss their company's plans and strategies for the following year—or five.

Why is there such skepticism about forecasting amongst top management? One of the reasons is that forecasting has often been the sole preserve of statisticians. But in many cases managers are better at forecasting than statisticians are. That does not, of course, mean that the manager can outgun the statistician in mathematics. It does mean that *some* managers are able to develop the forecasts delivered by their statistical departments into ones that are more accurate and, most importantly, more credible than those delivered by statisticians.

This is not a slight on the forecasting fraternity. Indeed, as a group they have achieved better results than managers have. In general, statisticians that engage in forecasting as a profession are more likely to produce better forecasts than managers, as a group, are. But *some* managers are better. These managers are doing things differently. Their intuitive models are more representative of the domain in which forecasts are made than the models used by statisticians.

In order to discover what makes these managers better at forecasting—and whether a manager's forecasting skills can be improved—it is necessary to examine the essence of statistical forecasting practice.

> "...what enables the wise sovereign and the good general to strike and conquer and achieve things beyond the reach of ordinary men is *foreknowledge*."
>
> *— Sun Tzu, The Art of War*

The forecaster's toolbox

Any worthwhile textbook on forecasting will provide a comprehensive array of techniques that can be used for forecasting. The techniques appropriate to any given forecasting situation depend on numerous factors, such as the amount of data available, the nature of the phenomenon being forecasted, the time horizon of the forecast and many others. Characterization of the forecasting problem in terms of these factors will allow the astute forecaster to dip into the toolbox and find an appropriate technique—or at the very least, the *most appropriate* technique, since there are no guarantees that a good technique necessarily exists for the phenomenon being forecast.

1. *This is an abridged version of the original paper. Copies of the unabridged version are available from Technology Surveys International. See page 3 for contact details.*

But what is at the core of the forecasting process? In essence, the whole world of mathematical forecasting relies on the principle that the phenomenon and its associated dynamics can be represented mathematically—that is, that some form of mathematical model can be constructed. A model is a simplified version of the reality. It cannot accurately represent the complexity of the world, because if it did, it would imply that the world itself is reconstructed—an expensive endeavour indeed. Since the model is then merely a simplified representation of reality, certain key assumptions are made in developing the model. And those assumptions are chiefly about how reality can be simplified for modeling purposes.

A good mathematical forecast is generated when the influence of variables *not* taken into account in the model is small. The converse is also true.

Some of the techniques used to generate forecasts mathematically rely on the past to predict the future. ***Time series forecasting*** techniques yield particularly good forecasts where the future is adequately modeled by past behaviour.

Then there are the ***causal modeling*** techniques, which try to emulate the cause and effect relationship between the input and the output of the system being modeled. Regression, econometric modeling, structured equation modeling and neural networks all attempt to do this in some form or other. But the essence is still the mathematical model of reality.

Models have improved over time, especially with the advent of cheap high power computing and concomitant developments in software. This has meant that the amount of complexity that can be embedded in the model has increased dramatically. And by and large, so has forecasting accuracy.

The essence of the problem

The essence of the problem, though, is that a mathematical model is, by definition, a simplification of reality. To illustrate some of the shortcomings, by example, some years ago the author was working on the problem of predicting the position of a maneuvering aircraft in order to close the 'time-of-flight' balance—the time that it would take a shell fired at the maneuvering aircraft to reach the aircraft's future position. A Royal Navy officer that had been working on the problem for many years made the memorable comment that, "There is no way in which you can predict where that aircraft will be in ten second's time because the pilot himself has not made up his mind yet. And his actions may change as a result of the shell being fired."

Implicit in this comment are a number of truths about forecasting. The first is that, even if the exact track of the aircraft were known from the time it took off—indeed even if the complete flight history of the aircraft were known—it would not assist in forecasting the future position of the aircraft in that critical time period, because at that time the flight history has very little influence on the aircraft's future position.

Secondly, in many cases the future may depend on significant and influential events that have not yet happened. And unless the forecasting model is able to model these events, and link their relationship to the phenomenon being forecast, the model could be highly inaccurate.

Does this apply in a business situation? Indeed it does. One of the biggest problems in business is forecasting in time of instability. For example, the onset of a downturn in the market can have a major impact on a company's business strategy. Predicting the timing and severity of the recession could therefore be pivotal in a company's success. In forecasting parlance, this is tantamount to predicting a turning point. This is precisely where mathematical forecasting is at its weakest.

In order for a forecasting model to predict a turning point it needs to have modeled it accurately. Some forecasting models have a special cyclical component for emulating the business cycle. But the underlying principle is that the business cycle will behave in the same way as it has in the past, unless some other dynamic—which should also then be modeled—has an influence on it.

Predicting turning points is not the only problem associated with mathematical forecasting

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"…the general who wins a battle makes many calculations in his temple ere the battle is fought. The general who loses a battle makes but few calculations. Thus do many calculations lead to victory, and few calculations lead to defeat: how much more no calculations at all!"

—Sun Tzu, The Art of War

Forecasting techniques

The field of forecasting has developed rapidly over the last two decades. The following forecasting techniques are in common use:

Time series techniques

- Classical Decomposition
- Holt's 2-parameter (damped and undamped)
- Winter's 3-parameter (damped and undamped)
- Autoregressive Integrated Moving Average (ARIMA) and Box-Jenkins

Causal Techniques

- Econometric Modeling
- Single and Multiple Linear Regression
- Structured Equation Modeling
- Neural Networks

Other Techniques

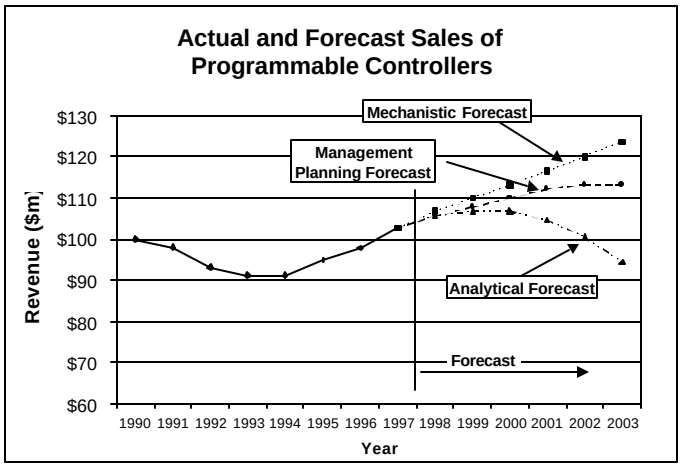
- Subjective Assessment
- Catastrophe Theory
- Normative Models
- Scenario Development

techniques. Another important one—one which is critical in many situations—is that mathematical techniques tend to be hungry for data. Generating a monthly seasonal forecast of demand for a product typically requires a minimum of 24 data points. A forecast of a stable business cycle would, ideally, require data from two consecutive business cycles, say, fifteen years worth of data. In a mathematical sense, having only a few data points provides very little information to examine the quality of the forecast.

Does this mean that mathematical forecasts are not worth pursuing? Not so. Mathematical forecasts provide useful insights to the manager. The key to successful forecasting, however, is to understand the limitations of mathematical forecasting techniques and try to compensate for those by other means.

Generating better forecasts

There are a few important principles to consider in order to develop effective forecasting techniques. Information theory suggests that the best decisions are made when all of the information inputs are used. In statistical forecasting techniques, all inputs have to be reduced to numbers before they can be integrated into the forecasting model. Statisticians often have a problem in breaching the chasm between the qualitative and quantitative worlds. Managers, on the other hand, are less concerned with mathematical integrity, and more with business effectiveness. Merging these two streams of knowledge can yield superior results.



How, then, can an organization improve its forecasts? The starting point is the ***mechanistic forecast***, the forecast that is derived from the best available data and statistical techniques. In many organizations the forecasting process stops there.

In order to be in a position to improve the forecasts it is imperative that the underlying assumptions for the forecasts are identified and understood. The ***analytical forecast*** then takes the mechanistic forecast and modifies it based on expectations of how developments in the macro-environment and task environment are likely to influence the forecast. Essentially this should be done as a two step process, first of all examining macro-environmental influences and then influences from the task environment.

The macro-environment consists of all those variables which may have an impact on the phenomenon, but over which the organization has no control. For example, changes in monetary policy may influence long term interest rates, which could have an impact on demand for capital equipment.

The manager's role becomes even more important at the task environment level since that is the immediate environment in which the company operates. It consists of customers and potential customers, competitors, channel members—all the players that have a direct impact on the market. Usually good managers will be in a better position to understand how the dynamics playing out in the industry will influence business forecasts than statisticians, since managers tend to interact with the task environment on a more regular basis. Astute managers may have specific intelligence, perhaps even inside information, on what may transpire in their market or industry.

Customer and competitive intelligence becomes critical in such a situation. Integrating competitors' future actions, or the future actions of large customers or channel members becomes important in modifying the forecast in a way that improves its accuracy. The analytical forecast thus becomes the 'best' forecast, since it is based on the 'best' mechanistic forecast, and has been modified to take environmental factors into account.

The process does not end there. In many cases, an organization's own policies and actions have an influence on the phenomenon being forecast. For example, top management policy decisions can have a direct influence on sales of a specific product. Managers should then able to modify the analytical forecasts—the best forecast available prior to taking manage-

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ment policies and actions into account—in yet another way so as to recognize the influences of those actions. It is important to treat this as a separate step, since it will allow the organization to gain insight into how those policies and action plans are likely to influence the analytical forecast. The result is the ***management planning forecast***.

The following eight steps summarise the process for effective forecasting.

Step 1: *Identify the key variables for which forecasts are required.* Typically, these would be important variables in a business plan, such as sales or production volumes, industry growth, market share and so on.

Step 2: *Obtain good source data for these variables.* There are numerous sources of data, for example, Statistics Canada, market research companies, industry associations, internal records or even competitors.

Step 3: *Generate good mechanistic forecasts*, using the best available statistical techniques at your disposal. There are many software packages on the market which facilitate this process—with varying degrees of pain.

Step 4: *Select a panel of managers who are aware of developments in the macro- and task environments* and ensure that they understand the overall forecasting process. Ensure that the panel develops a detailed understanding of the underlying assumptions for each of the forecasts generated. It is important to include those people responsible for generating mechanistic forecasts in the panel since they provide valuable insight into the underlying assumptions, and into which dynamics have been taken into account in their models.

Step 5: *Modify mechanistic forecasts based on managers' expectations* of changes in the macro-or task environments. This is often best done in a workshop setting with an independent facilitator who is able to examine management inputs critically and ask penetrating questions. Some organizations have promoted a modified Delphi technique. TSI's experience is that nominal group techniques provide excellent results.

Step 6: *Modify the analytical forecasts generated based on managers' insights* as to how management policies may influence these forecasts.

Step 7: *Check consistency with other forecasts* to ensure that the final forecasts agreed upon are consistent with others in the same suite. For example, it would be inconsistent to forecast increased product sales but declining production of that product (unless, of course, inventories were being run down).

Step 8: *Critically review the forecasts generated on a periodic basis*, taking care to learn from forecasting errors and to improve critical thinking rather than using it as an opportunity to allocate blame. In many cases more can be learnt from an incorrect forecast than from one that is spot on.

It is important to ensure that the whole organization is using the same suite of (consistent) forecasts for planning. Very little benefit can be derived if production is working off a different set of forecasts to that which the marketing department is using.

Finally, it is important to remember that some variables will be very difficult to forecast. ***Scenario planning*** can provide organizations with a valuable tool for coming to grips with the 'cone of uncertainty' for events which may be highly improbable, but which may have a significant impact on the organization.

And what would the benefits of instituting such a forecasting process be? In the first instance, the forecasts generated by your organization would almost certainly improve. This would result in reduced business risk and increased profitability. Secondly, it would promote management buy-in to the forecasts, and hence commitment to management action plans derived in the business planning process. Thirdly, it provides an opportunity for your organization to improve its insight into the dynamics influencing the industry in which you operate. Important benefits indeed! ¤

The Vested Interest

"There is no way that I will support a study which shows that the high growth that we are expecting for this industry will not materialize. I don't want to lose my association membership overnight."

Things to look out for

Maintaining objectivity is the single most important challenge facing managers in forecasting—which is why only *some* managers are good at it. When using management inputs to modify forecasts beware of the most common pitfalls, namely:

- Vested interests
- Political agendas
- Accepting information at face value
- A fear of failure and hence an unwillingness to contribute unique insights
- Overenthusiasm or extreme optimism
- Paradigm lock—managers' unwillingness to accept that important changes could face the company/industry

About the Author

Christie Christelis has a BSc (Eng.) degree in electronics, a Graduate Diploma in Engineering and an MBA. Early in his career he was involved in the design and development of systems for the aerospace industry, including the development of advanced prediction models. He has been actively involved in industry analysis and forecasting for the past fourteen years. He has consulted to leading technology companies in a number of different countries.