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Beyond the oracle

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The priests of Delphi have not been alone in providing forecasts for a price. Since the dawn of civilisation, a great many fortune tellers, soothsayers, wizards, augurs and astrologers have sought to fulfil the human need to predict the future. Even today, forecasting based on principles similar to those employed in Delphi is common. Horoscopes geared to the general public are the most obvious example. Forecasts for stock exchanges and futures markets, predictions for exchange or interest rates, as well as forecasts of recessions and booms fall into the same category. In spite of the claims made for such forecasts, there is very strong evidence that their predictive usefulness is nil, just as were the predictions made in Delphi, writes Spyros Makridakis, research professor at INSEAD in France.

The temple of Delphi is located in the middle of a mountain range on the south of the Greek mainland. The view from it is awesome; excellent visibility allows one to see a good part of the Gulf of Corinth and northern Peloponnese. The blue of the sky and the sea are perfectly blended with the green of the mountains to provide a unique, breath-taking image, difficult to forget. In such a setting the priests of Delphi operated the first formalised forecasting service.

To reach the temple required a long and tiring climb up the mountain. The hospitable priests, however, gave their guests a warm welcome. Good food and plentiful wine were made available to the exhausted traveller who, while eating and drinking, was encouraged to talk about himself, his needs, desires and expectations.

The temple of Delphi became the richest institution in ancient Greece. Its powers of prophecy were believed in by everyone, because they were attributed to Apollo, the God of the Sun, who could see and therefore foretell the future for all those who could afford the services of his oracle. The oracle, Sibyl, based her predictions on principles, which make their invalidation difficult. They often foretold what those seeking advice were expecting to hear. If this was not possible, the prophesies were equivocal; their wording was obscure, they were general, or they were difficult to check against reality.

Over the last 30 years the field of forecasting has evolved into a solid scientific discipline. One of its greatest achievements has been the analysis of millions of forecasts made in the past. The empirical evidence collected through such an analysis has allowed us to understand better the advantages and limitations of forecasting, to know more precisely what can and cannot be predicted and to see what steps can be taken to increase its usefulness and relevance.

Executives can benefit from formal forecasting methods. Strategy formulation, planning and future oriented decision-making all require predictions about the future. If these predictions are timely, accurate and realistic, considerable strategic and/or operational benefits can be attained.

This article presents the latest thinking in the field of forecasting and discusses ways that it can be used by business organisations to make the most of its benefits while avoiding its disadvantages.

The predictability of the future

Can the future be predicted? The answer is "it depends." Certainly some aspects of the future can be predicted with a high degree of accuracy, whereas others are less predictable, or completely uncertain. The exact timing of sunrise tomorrow or a year from now can be forecast with a precision measured to

hundredths of a second. However, it was practically impossible to have predicted that the price of a barrel of oil would rise from $2 in 1973 to $39 in 1979 and then drop to $15 in 1986. But how can we know what can and cannot be predicted?

All types and forms of forecasting are extrapolative in nature. This means that available information or data is analysed to discover patterns and/or relationships, which are then extrapolated in order to predict the future. When historical data is available, the forecasting methods used are called *quantitative;* otherwise they are referred to as *judgemental.*

The approach followed by all quantitative methods and most judgemental approaches is to discover some pattern and/or relationship that has held true in the past and then to use such a discovery as the basis for predicting the future. Examples of this approach are numerous. For instance, looking at past data we might find that sales increase 3% a year and that, on average, sales during the month of August are 20% above the mean of the year. With these two pieces of historical information we can extrapolate from the present to predict the sales in, say, August 1987. The basis of this forecast is the assumption that a pattern has been identified and that such a pattern will not change during the time horizon of the forecast. Obviously, the discovery of patterns in the data can be based on more sophisticated approaches than the one just mentioned. For example, we might want to give more weight to recent months, include the cyclical aspects of the economy in the forecast, or incorporate information about future technologies. However, no matter how sophisticated or complex the forecasting approach, its basis is always extrapolative.

An alternative to discovering established patterns is that of finding existing relationships. For example, if the forecaster can work out how advertising and prices affect sales, the relationship can be used to predict sales at a future time when advertising and prices will be different from those of today. The principle used here is also extrapolative. Past data is analysed to identify and measure existing relationships, which are then extrapolated in order to make a forecast.

Judgemental forecasting approaches use similar principles, although they are more flexible in the way they use past information and in the way they extrapolate established patterns or relationships. This is often done by incorporating into the forecasts the consequences of goals and objectives and the interplay among the various factors involved in influencing the future.

As long as established patterns and/or relationships do not change, forecasting methods will do well in predicting the future.

Their errors will usually be within acceptable limits with no surprises or unexpected outcomes. But what happens when there is a change in the existing patterns or relationships? Well, the answer is simple: the size of the forecasting error would depend upon the extent of change. For example, if for the last 20 years the sales of company XYZ were increasing 3% a year, and then for some reason this growth is destined to become 1% after 1986, there is no way that any forecasting model extrapolating a 3% yearly increase will accurately predict the sales of 1990. Similarly, when the relationship stating that inflation is high during periods of economic boom and low during periods of recession held true, it was relatively easy to forecast. However, once the relationship no longer seemed to hold (ie, during the 1973/75 and 1980/81 recessions) it became impossible to predict inflation accurately, or to know what to do to bring it down.

Unfortunately, there is no practical way of predicting what will happen when established patterns or relationships change. Moreover, it is not usually possible to know when such changes will take place, or what their intensity will be. Available forecasting methods, because they proceed by extrapolating past patterns and/or relationships, work well only when the future resembles the past, or when changes, by chance, happen to cancel themselves out. In all other cases they cannot work properly. Human judgement is the only alternative in finding out the effects of systematic changes, the factors involved and their consequences.

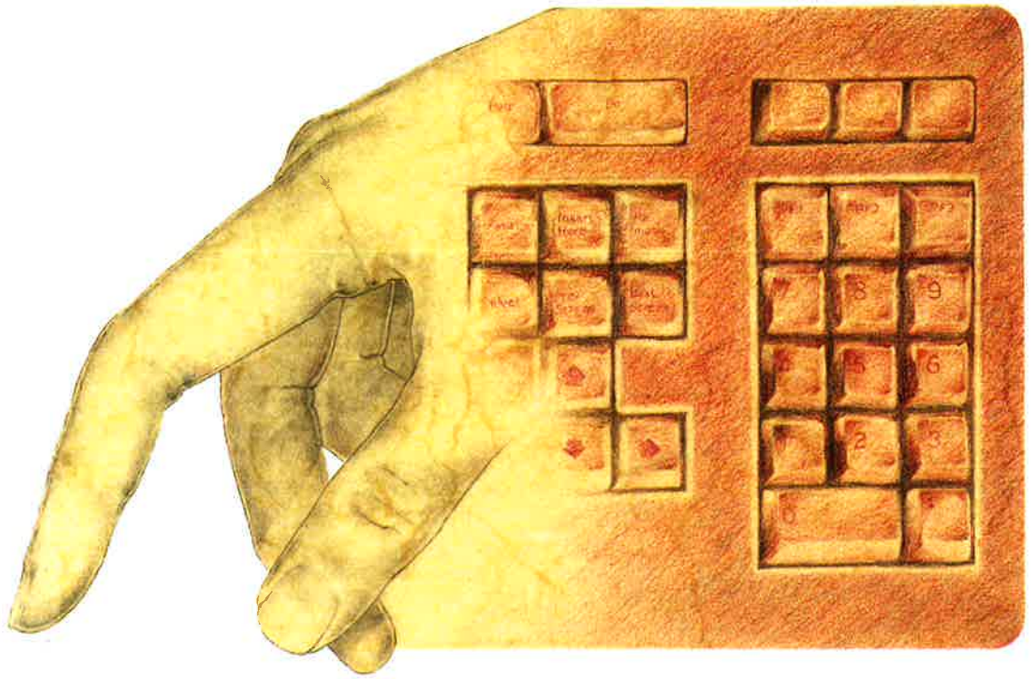
There are serious limitations, however, to the systematic changes humans can predict. Humans are not prophets either. They also base their forecasts on observing existing trends, changes in attitudes, future goals, emerging needs, technological and market developments, new governmental policies and so on and then extrapolate them to predict the future. The advantage of human forecasters is that they are quicker in identifying systematic changes and in understanding how such changes will affect the future. Their disadvantage is that they can be wrong while believing they are right. Furthermore, they may have vested interests in persuading users of forecasts that they can predict the future accurately.

In the physical and natural world, patterns and relationships do not change, or when they do, they change slowly and usually in a predictable way. This is why forecasting can be extremely accurate. In the business sphere, however, patterns and relationships usually change in an unpredictable way. Furthermore, unforseen events take place (eg, the 1973/80 energy crisis). In addition, people through their actions can influence future events. Under such circumstances is it at all possible to forecast?

There is no doubt that forecasting economic or business events is difficult and that even the best forecasting method cannot eliminate future uncertainty, or predict the unexpected. On the other hand, what is the alternative? Predictions about the future must be made whether or not a formal, systematic approach is used. It should be realised, however, that intuitive, purely judgemental forecasts do not necessarily produce better results. Thinking carefully about the future in a formalised way helps a company to understand better the factors involved in shaping the future and their consequences. Moreover, it helps the company prepare to face such a future.

Executives know that a large amount of forecasting is required for operational purposes. Goods must be produced and shipped, services rented, cash or cheques received, expenses paid, personnel hired and investments made. All of these require hundreds (in many companies even many thousands) of forecasts that need to be made at regular, short intervals (eg, each week or month). In addition, forecasts for quarterly earning reports, budget estimates, capital outlays and long range predictions for strategic purposes are needed. The process of making these forecasts cannot be left to individual initiative; it must be formalised. Otherwise, inefficiency and inconsistency prevails, with detrimental results for operational effectiveness and profitability. The evidence available clearly indicates that a systematic approach to forecasting improves operational planning and decision-making.

A considerable amount of empirical evidence exists to show that judgemental forecasts made by people are not necessarily more accurate than similar predictions based on quantitative methods. This is true even of people who are knowledgeable about their markets and business. The reason is not that people are not as good as systems in identifying and extrapolating established patterns or relationships. Rather, people are not necessarily objective. People are also inconsistent and cannot easily deal with



routine, repetitive tasks, or a mass of details. Forecasting methods and computers are ideally suited to deal with such tasks.

What we have learnt through empirical evidence and experience working with businesses is that people and forecasting methods are complementary and must be integrated to gain the maximum benefits.

How accurate are forecasts?
What errors should be expected from forecasting? Table 1 shows the Mean Absolute Percentage Errors (MAPE) from a large empirical study. About the same level of errors has been reported in a recent survey among forecasting users.

Table 1

Typical size of forecasting errors (Mean Absolute Percentage Errors, MAPE)

	Forecasting horizon (in respective periods of time)							
Type of data	**1**	**2**	**3**	**4**	**6**	**8**	**12**	**18**
Yearly	7	10	16	18	25	—	—	—
Quarterly	8	12	16	25	30	37	—	—
Monthly	9	11	12	12	18	21	24	30
All	8	11	13	15	21	25	24	30

Most users may not accept the size of these average errors. However, this is what can be expected on average and planning must be able to deal with errors of such magnitude.

Why does forecasting go so awry?
Although forecasting economic and business events will always involve errors and uncertainty, some forms of forecasting are more accurate and less uncertain than others. Furthermore, people are better equipped to forecast certain situations, while quantitative forecasting methods are more appropriate for some others.

[illegible] the time horizon of forecasting is a crucial factor in determining both accuracy and uncertainty. As the time horizon increases, accuracy decreases and uncertainty increases. Inertia in economic and business trends makes immediate and short term forecasting more accurate and less uncertain. Even when abrupt changes occur, it takes time to deviate from the established course. It took almost a year, for instance, after the oil embargo of October 1973 for the 1973/75 recession to gather full impetus. As the time horizon of forecasting increases, inertia becomes less important and the chances of systematic changes in patterns or relationships

increases. Since quantitative methods cannot predict such changes, the greater the horizon, the greater the need for judgemental forecasting.

Seasonality of demand: seasonality in products or services does not change frequently and when it does the change is gradual. This means that seasonal variations can be predicted accurately through standard quantitative methods. As a matter of fact, one of the most important benefits from quantitative forecasting is its ability to predict accurately the seasonality of demand or other variables.

Durability of demand: mature products are easier to make predictions about as their demand is well established. Paper consumption, for instance, has been increasing on average by about 3.5% a year and it has done so since the early 1950s. The demand for new or fashion products, on the other hand, can fluctuate widely. No established patterns or relationships exist on which to base the forecasts. The demand for video games, for instance, collapsed in a matter of months in early 1984 as children became bored with such games and switched to home computers. Similarly, it is much easier to predict the sales of men's shirts than fashionable women's clothing. There are too many factors determining the demand for fashion clothing, which cannot be quantified accurately. In such cases, judgement becomes more important.

Although the trend for a mature product is stable there is always a chance that it might change. The uncertainty, furthermore, increases as the forecasting horizon becomes longer. A poet has put it well:

A trend is a trend,
But the question is, will it bend?
Will it alter its course
Through some unforseen force
And come to a premature end?

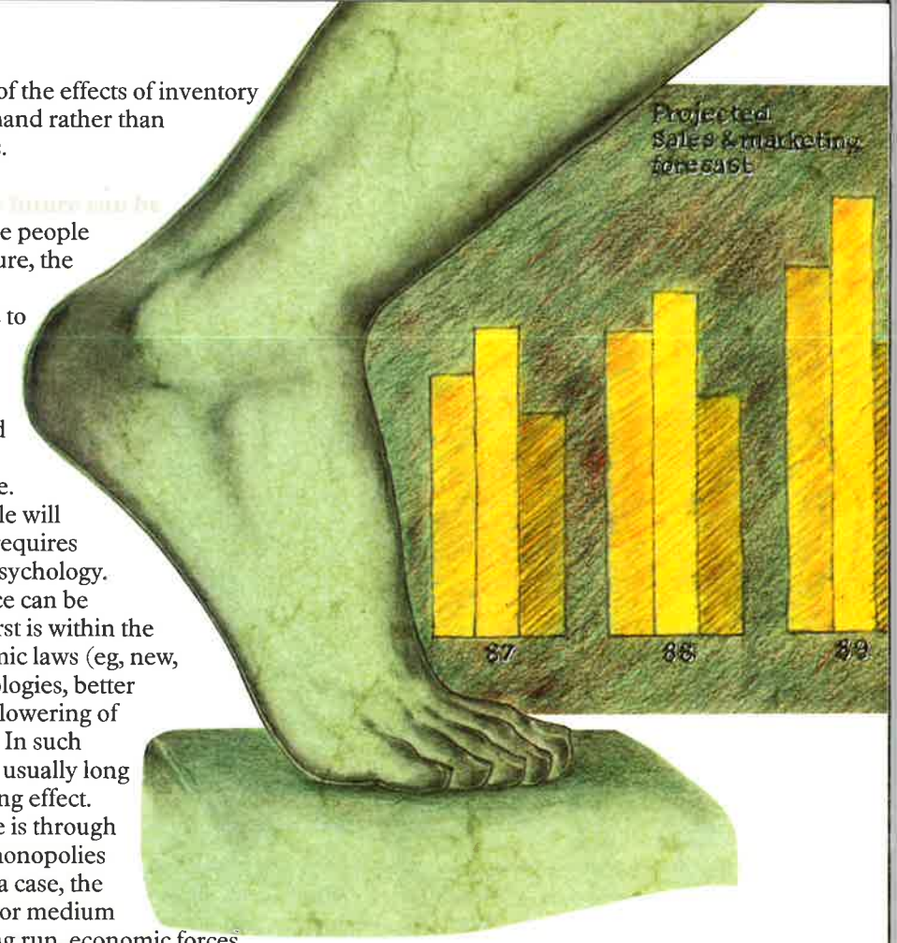
Cyclicality: some industries and companies are affected a great deal by cyclical fluctuations in the economy (or other environmental factors). Forecasting such cyclical changes is not easy, as the length and depth of cycles vary – sometimes considerably. This makes it difficult to forecast cyclical changes by quantitative methods alone. Companies in non-cyclical industries (food, banking, medical care) can rely more on forecasting methods than companies in cyclical industries (automobiles, steel, agricultural equipment) which cannot expect to predict cyclical fluctuations accurately.

Since predicting cyclical changes is not an easy task, the next best alternative is to monitor the present as closely as possible and devise strategies to deal with the unpredictability of the cyclical changes.

New product forecasting: unless the prediction of new product(s) can be based on analogies with similar existing product(s), no patterns or relationships can be established, on which to base the forecasts. This means that judgement, supplemented by market research, is the only available alternative. Empirical evidence has shown that the size of forecasting errors and the uncertainty involved with the forecasting of new products is huge. Not much can be expected from quantitative methods to reduce the size of the errors or the uncertainty, since a quantitative model can only be developed when sufficient data is available.

Number of customers: the larger the number of customers, the more appropriate the use of quantitative methods. From a statistical point of view, the law of large numbers ensures smaller deviations from the 'average' pattern or relationship and hence more effective forecasting. When sales depend on a few customers, forecasts can vary to a much greater extent as the influence of one, or a few customers can greatly affect sales. It then becomes important to know the intentions of big customers through personal contacts and inside knowledge. Obviously quantitative methods cannot achieve such a task, so judgemental forecasts are the only alternative.

Level of aggregation: sales made directly to the end customers require one level of inventory only. This allows an easier identification of changes in final demand. If inventories between the manufacturer and the retailers exist at more than one level, forecasting is much more difficult, since it is not usually easy to identify changes in inventories at different parts of the distribution chain. Inventories act as buffers absorbing changes in final demand, which cannot be known to the manufacturers until they have been depleted/increased to desired levels. So again, we need personal judgement of the effects of inventory changes on final demand rather than quantitative methods.



Extent to which the future can be influenced: the more people can influence the future, the more difficult it is for quantitative methods to predict it. People's actions can change established patterns and relationships and render quantitative forecasting inaccurate. Predicting how people will influence the future requires knowledge of mass psychology. Two types of influence can be distinguished. The first is within the framework of economic laws (eg, new, more efficient technologies, better products or services, lowering of production cost, etc). In such cases the influence is usually long term and slow in taking effect. The second influence is through cartels, oligopolies, monopolies and so forth. In such a case, the influence has a short or medium term effect. In the long run, economic forces will nullify this second form of influence. A good example is OPEC, which managed to keep oil prices artificially high from 1973 to about 1983. High prices, however, triggered a series of economically based responses with the effect of lowering prices to levels, which are close to those of historical trends when inflation has been taken into account. (In 1950 the oil price was $2 a barrel. Assuming prices, because of inflation, doubled every 12 years the present price should be about $16 a barrel. In fact, at present, it is at about this level.)

Frequency of forecasts: the more frequent the forecasts, the higher the necessity to use quantitative methods. Because of the law of large numbers, forecasting errors will be close to those expected. Furthermore, people become bored easily with routine, repetitive tasks. Boredom reduces motivation and brings inconsistency and unnecessary errors, since those involved cannot concentrate on tedious, monotonous tasks for long. Quantitative methods and computers, on the other hand, can perform repetitive functions extremely well on an automatic basis. They should, therefore, be preferred over people, who should concentrate their efforts on adjusting forecasts when necessary.

Improving forecasting effectiveness

How can executives benefit the most from available forecasting methods, while minimising future uncertainty? Although many methods exist, choosing the most appropriate among them is not difficult. Strong empirical evidence gathered over the years indicates beyond doubt that *no* forecasting method or forecaster has outperformed the others on a consistent basis. Instead there is very strong evidence to suggest that forecasting accuracy is improved and uncertainty reduced by combining the forecasts of several methods and/or forecasters. This means that the best way of forecasting is to average the predictions of several (three or four are enough) methods and/or forecasters. Furthermore, there is very strong evidence to indicate that sophisticated

methods do not necessarily provide more accurate forecasts than simple ones. Executives do not have to worry, therefore, about the fanciest mathematical model, the most expensive forecasting service, or the biggest, most complex technique. Simple methods suffice to provide adequate forecasts. Simple methods are easier to use, require few data and little computer time. They should, therefore, be preferred by both large and small companies, unless it can be proved that other more expensive and complex alternatives can improve forecasting accuracy.

Unfortunately, quantitative methods cannot be used unless data is available and some other conditions prevail. As we have seen, quantitative methods are more appropriate when data is seasonal and non-cyclical, for mature, non-fashionable, consumer products sold directly (with or without a few intermediaries) to customers when people cannot influence the future a great deal and when the forecasts are made frequently for a large number of items. The more of these factors that are present, the stronger are the benefits of using quantitative methods on a routine, automatic basis. Otherwise, judgemental forecasts are necessary to supplement whatever objective information is available. The uncertainty of such forecasts, however, is large and cannot be assessed correctly.

Formalising the process of forecasting can improve predictive accuracy considerably and reduce uncertainty. Thus, instead of approaching each situation on an *ad hoc* basis, it is preferable to develop and systematically apply decision rules for dealing with similar forecasting tasks. People's efforts can then concentrate on deciding what rule to apply when existing rules are not valid any more and should be modified, or when new rules should be added.

Decision rules have three main advantages. First, they save time. Instead of dealing with tens or hundreds of individualised situations, such situations are classified into categories, which are dealt with in the same systematic way. Secondly, they call for careful thinking by several people to discover the appropriate decision rule(s), whose importance can be tested and whose influence can be measured, if quantitative inputs are available. Thirdly, any improvements from applying the decision rules can be determined and this knowledge used in making further improvements.

Computers and data banks can also make forecasting easier. Several computer programmes are available, both on mainframe and micro computers, which allow the use of all major forecasting methods. The cost of these programmes is within the reach of even small companies. Moreover, most of these programmes are written for managers, so they require little technical skill or computer knowledge. In addition, you can access data banks commercially to obtain the great majority of economic and financial macro-data necessary for company forecasting.

What is not readily available is internal data, the prerequisite for starting a forecasting function. Although data collection is a time consuming task (past records must be consulted to find the units or dollar sales, orders, costs or whatever other variable executives want to predict), it must be done before you can use forecasting methods effectively.

Implications for planning and strategy

Forecasts are made for three purposes: (a) curiosity reasons (b) operational planning (personnel scheduling, production, financial and marketing planning, purchasing, budgeting, etc) and (c) strategic planning (capital expenditure, R&D expenditure, new markets to compete in, new businesses to operate and so on). Obviously the latter two are the most important for business purposes.

A key element in operational planning is the lead time between a decision to do something and the end result. Thus, if the production cycle is two months, the lead time for planning is at least two months and the forecasts should similarly cover at least two months. Since forecasts can be inaccurate, the operational plans must incorporate the possibility of errors. The uncertainty caused by short term forecasting errors can be reduced by shortening the lead time of planning – for example, through computerised planning systems and just-in-time planning approaches.

The uncertainty of medium term forecasting, used mostly for budgeting purposes, is more difficult to reduce. Recessions and booms, with serious implications for sales, can occur during the budget period. They, unfortunately, cannot be successfully predicted (or have not been so far). This calls for a change in attitudes. Business cycles must be treated similarly to bad debts, which cannot individually be predicted.

THE COMMON MISTAKES IN FORECASTING

If large forecasting errors, or other problems exist, do not attempt to solve them by the following:

Abandoning forecasting methods

REASON: Dealing with planning and strategy will be even more problematic if no formal forecasting is done.

Substituting people instead of forecasting methods

REASON: People do not necessarily produce more accurate forecasts than quantitative methods. At the same time, their forecasts are usually more expensive.

Using more sophisticated methods

REASON: Empirical evidence has shown that sophisticated methods are not necessarily more accurate than simple ones.

Subscribing to more expensive newsletters, or several forecasting services

REASON: Empirical evidence has shown that forecasting accuracy is not improved by buying more expensive forecasts.

Assuming that present economic conditions will continue forever

REASON: History has shown that cyclical factors, whose effect is temporary, have always influenced business and economic affairs.

So companies should build a recession fund during periods of boom, to be used during periods of recession. This would be a more realistic attitude than expecting (or pretending) that recessions can be predicted.

Long term forecasting must identify changes in trends and attitudes as well as the impact of new technologies. It will involve a high degree of uncertainty. Furthermore, even high forecasting accuracy cannot guarantee success. In the 1960s, for instance, all major firms in the electric appliances industry correctly predicted the market growth. Most of them, however, planned their capacity expansion assuming that their competitors would not attempt to capture part of the growing demand. The end result was overcapacity, a price war and losses. The same has been true with computers. The exponential growth in demand for computers has been predicted accurately. This, however, has intensified competition, brought overcapacity and resulted in more bankruptcies than in any other industry.

The uncertainty in long term forecasts must be accepted and dealt with through a flexible and adjustable organisation, which has accumulated enough reserves to be able to adapt when it has been determined that the changes in the environment are permanent. Expecting to reduce the uncertainty in long term forecasts is illusory. Instead, executives have to monitor the environment for changes (several methods are available to do this). Furthermore, they must concentrate their efforts to distinguish temporary versus permanent change. This is another difficult task which cannot be dealt with by quantitative forecasting methods.

Conclusions

Planners and strategists must, most of all, be realistic in what they can expect from forecasting.

Executives ought to understand and accept the advantages and limitations of forecasting. Quantitative forecasting is the best way of identifying and extrapolating established patterns or relationships. Its biggest benefits derive from routine utilisation – frequent forecasts of a large number of items. Its biggest disadvantage is that it cannot predict systematic changes from established patterns or relationships. Furthermore, it requires data on which to base its predictions. Judgemental forecasts are complementary to quantitative ones and effective ways of integrating the two must be developed. Forecast users must, in addition, deal with the issues involved in improving the forecasting function and effectively integrating it into planning, strategy and decision-making in general.