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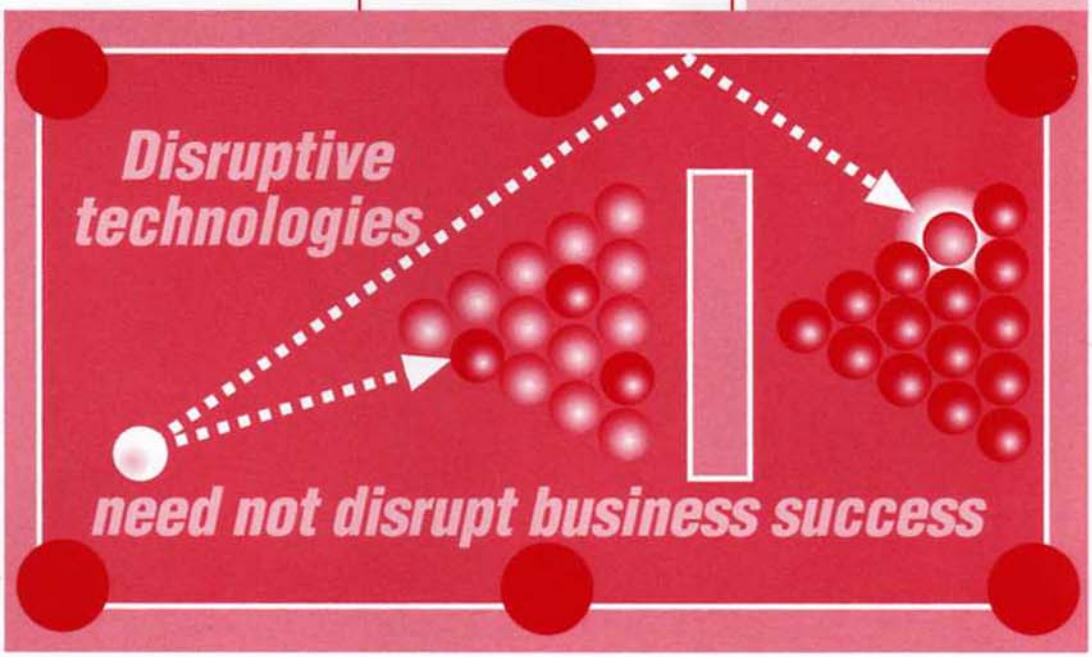

TESTING THE TEA LEAVES: EVALUATING THE VALIDITY OF FORECASTS

A variety of formal methods exist but decision-makers should also apply a systematic assessment framework.

John H. Vanston and Lawrence K. Vanston

OVERVIEW: *All business decisions are based on forecasts about future markets, financial realities, operating environments, technologies, and a host of other relevant factors. Because the effectiveness of these decisions will depend, in large measure, on the validity of the forecast, it is highly desirable that managers and executives have practical ways for testing this validity. The two most common reasons for poor forecasts are the use of unreliable or outdated data and the use of inappropriate forecasting models. Techniques exist for testing forecasts for each of these shortcomings.*

Planning is, by definition, oriented to the future. No one makes dinner plans for last week. No successful manager is truly interested in the present, except with regard to how it can be changed for the future. Thus, all business plans, all financial plans, and all marketing plans are based on projections about how the future will unfold. These projections—forecasts—can be formal or informal, implicit or explicit, short term or long term. However, regardless of the type of forecast used in business planning, the success of the plan will, in large measure, depend on the validity of the forecast.

Because of the importance of valid forecasts and because the people charged with making key business decisions typically rely, to a great extent, on forecasts made by others, it is essential that planners, executives and other decision-makers be able to assess the validity of various forecasts. In making such assessments, these people typically rely on the reputation of the forecaster, the results of past forecasts, or their personal comfort with the forecast. However, in many cases, a more formal assessment of a forecast can be of significant value to people who must stake their reputations and careers on its validity. The purpose of this paper is to

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provide a set of tools that can assist in making such an assessment.

The authors' 30 years of forecasting experience involving more than 150 companies, government agencies, associations, and academic institutions, including more than half of the technology-oriented *Fortune* top 50 companies, has convinced us that there are two primary reasons for forecast failures: the use of inappropriate or outdated information and the use of improper models. It appears reasonable, therefore, to use procedures that will test each of these factors.

Two general types of data are typically used in forecasting: statistical data and expert opinion. Tests for the two types of data are similar, but do have significant differences.

Statistical Data

Statistical data should be examined for the following qualities:

Reliability of source

Obviously, data sources with long reputations for reliability and accuracy are more credible than those without such reputations. Data from official government agencies usually have strong credence, as do data from recognized authoritative sources such as professional associations, public service organizations, and media files. For example, a projection of school age population in future years by the U.S. Census Bureau could be accepted as quite reliable, both because the organization has a long history of accurate population projections and because most of the people reflected in the projection will have already been born. On the other hand, data presented in most companies' promotional material may well be subject to question.

A number of commercial organizations provide data for a fee. These vary from those that organize and publish data in a general subject area to those that provide data in narrow and specialized areas. The reliance that can be placed on this information depends on the reputation of the organization, its past record, and the credibility of the organization's own information sources.

E-mail and Internet websites offer a wealth of data to people familiar with their use. Although there are means of checking the accuracy of such data to some extent, in general, data obtained from such sources should be viewed with considerable trepidation. Of course, the most serious questions about reliability arise when the sources of data are not indicated at all.

Currency

Because the gathering of primary source data is both difficult and expensive, forecasters often extrapolate from old information or, for convenience, continue to use information that has grown long-of-tooth. Moreover, many forecasters use data available from other agencies without giving due regard to its timeliness. This shortcoming can be particularly serious in areas in which technologies, business practices and/or alliances, and market realities change rapidly.

Statistical data should be examined for reliability, currency, bias, and other factors.

In examining data for currency, it is usually desirable to determine if all of the data is historically based or if a portion is projected data. Obviously, projected figures are normally not as reliable as historical data. However, our experience indicates that information based on announced company plans is usually reasonably dependable.

Potential bias

Even information that is factually accurate can be misrepresented by improper emphasis, selected omission, or prejudicial organization. For example, the U.S. Department of Defense announced the success of an antiballistic missile weapon scoring a hit on an incoming missile but neglected to note that the a transponder had been placed on the incoming missile to assist its tracking (*1,* pp. 81–103). Such misrepresentation may result from the bias of the agency providing the information, and may either be deliberate or unconscious.

Certain biases may be suspected from the nature of the supplying organization. It would not be surprising that the American Gas Association and the Edison Electric Institute presented different pictures founded on the same basic information. Forecast data input should always be examined for natural bias.

Unconscious bias is more difficult to uncover because it is normally unintended and non-obvious. Often, examination of word choices ("uncontested"), stock phrases ("scientists report that"), or unusual organization of data (conclusions separated from supporting material) can be a tip-off to unconscious bias.

Gathering technique

Often, the technique employed in gathering the data can skew its validity. For example, Content Analysis is one technique for projecting the nature and rate of change. In this method, records are kept of the amount of media attention devoted to emerging issues. As the number of column inches devoted to an issue increases, it is assumed that its importance and probability increases.

The potential value of this approach has been well documented (*2,* Chapt. 1). However, one of the practitioners of this technique reveals that his organization does not include newspapers or magazines from any large American city, because of the belief that only small cities and rural areas truly represent American society (*3,* Introduction). Obviously, the data from this source would be considerably different from data based on the belief that opinions and ideas from cities such as New York, Los Angeles and Chicago are of some importance in defining the nature of our society.

Relevancy

Because of the difficulty in obtaining and organizing data, organizations often maintain records of information that is easy to obtain rather than relevant to the decision-making process. It is much like the old story of the man who looked for a lost coin in the place where the light was best, rather than in the place where the coin had actually been lost. In assessing statistical data, one must consider if the data being offered is truly relevant to what is being forecast. A simple test is to remove the information from the forecast and determine if the forecast is materially affected, either in its conclusions or the degree of support for the conclusion.

Expert Opinion Data

When statistical data is unavailable, of doubtful quality or of questionable relevance, forecasters often turn to data based on the reasoned opinions of experts in the field. Although such data is often believed to be inferior to statistical data, in many cases, this is not true. In fact, expert opinion is often used to support or counter statistical data. However, information garnered from experts in a given field must also be tested for reliability and significance.

Qualifications of experts

By definition, the term "expert opinion" requires that the information sources have qualifications in the area in which they are providing input. In evaluating the forecast, one should give careful consideration to the people who provided input to the forecast and to the expertise they bring to the process.

Information from experts must also be tested for reliability and significance.

Bias

We are all prisoners of our own pasts. Therefore, our observations and opinions are colored by our experiences, education and expectations. As with statistical data, these biases may be recognized and acknowledged or may be unconscious and denied. In either case, forecast assessors must be alert for such biases and be prepared to give them proper consideration.

Balance

Given the fact that every expert has, at least to some extent, a personal bias, forecast assessors should examine whether or not the panel of experts represents a divergence of profession, experience, background, and position. For example, in a recent forecast on nanotechnology, our company engaged a mixture of experts including scientists, engineers, environmentalists, venture capitalists, physicians, and lawyers. No panel can ever include every possible viewpoint; however, assessors should, at a minimum, determine if the panel is so out of balance as to encourage doubts about the validity of the forecast. Moreover, care must be taken to assure that each person's input is restricted to areas in which he or she has special qualifications.

Five Views of the Future

The second major cause of invalid forecasts is the use of inappropriate models in projecting how the future will evolve. In this instance, the term "model" is used to mean how the forecaster treats the myriad factors that will determine the future, as well as the interactions among those factors. One means for testing whether or not an appropriate model has been used is to examine the forecast in terms of a number of basically different models. The "Five Views of the Future™" framework discussed below provides an approach for utilizing a number of different models to test a forecast.

Five Views of the Future is a strategic analysis framework we developed in order to take maximum advantage of the variety of proven techniques and methodologies when conducting our technology/market

forecasts (*4*). The framework (see illustration) is based on the five ways people view the future:

Extrapolators believe that the future will represent a logical extension of the past. Large-scale, inexorable forces will drive the future in a continuous, reasonably predictable manner, and one can, therefore, best forecast the future by identifying past trends and extrapolating them in a reasoned, logical manner (*5,* pp. 18–21; *6,* pp. 169–174).

Pattern analysts believe the future will reflect a replication of past events. Powerful feedback mechanisms in our society, together with basic human drives, will cause future trends and events to occur in identifiable cycles and predictable patterns. Thus, one can best address the

This Five Views of the Future™ strategic analysis framework is designed to assist planners and managers in taking maximum advantage of the forecasting techniques listed under the five "view" categories. Typically, the people charged with accomplishing one or more of the tasks listed on the bottom of the diagram will analyze the contribution that each of the listed forecasting techniques can add to the project. Then the various techniques selected are integrated to produce the overall forecast or plan. In selecting specific techniques to employ, efforts should be made to select techniques from as many different categories as practical. Although the framework was developed to aid in project planning and execution, the concept can also be useful in evaluating completed forecasts.

future by identifying and analyzing analogous situations from the past (*5,* pp. 21, 31-32, 40-42; *6,* pp. 96, 104–106, 122).

Goal analysts believe that the future will be determined by the beliefs and actions of certain individuals, organizations and institutions (*5,* pp. 29–31; *6,* pp. 301, 303–323; *7*). The future, therefore, is susceptible to modification and change by these entities. Thus, the future can best be projected by:

- Examining the stated and implied goals of various decision-makers and trendsetters.
- Evaluating the extent to which each can affect future trends and events.
- Evaluating what the long-term results of their actions will be.

Counter-punchers believe that the future will result from a series of events and actions that are essentially unpredictable and, to a large extent, random. Therefore, one can best deal with the future by:

- Identifying a wide range of possible trends and events.
- Carefully monitoring developments in the technical and social environments.
- Maintaining a high degree of flexibility in the planning process.

Intuitors are convinced that the future will be shaped by a complex mixture of inexorable trends, random events and actions of key individuals and institutions. Because of this complexity, there is no rational technique that can be used to forecast the future. Thus, the best method for projecting future trends and events is to gather as much information as possible and then to depend on subconscious information processing and personal intuition to provide useful insights (*5,* pp. 25–28; *6,* pp. 89–92, 209–217).

Obviously, each of these views has its attributes and its shortcomings. *Extrapolators* utilize self-evident logic and take advantage of the fact that, most often, the future is founded on the past. However, this view does not take into account the changes in driving forces that can result in rapid and dramatic changes in trends.

Pattern analysts take note of the fact that history often does repeat itself. The adoption pattern of color television closely followed that of black-and-white television, which, in turn, followed the pattern of radio adoption. On the other hand, it is quite possible to choose an invalid analogy and, in any case, analogies are never exact.

Goal analysts take cognizance of the fact that technical and non-technical advances do not take place in a vacuum and understand the impact of strongly held beliefs and opinions in "real world" situations. However, it is often difficult to assess the dedication and potency of the various stakeholders involved in a given situation.

The challenge is how to use the Five Views of the Future framework to judge the validity of the forecast.

Counter-punchers give credence to the complex, interactive nature of our society and the fact that the results of events and decisions are often quite different from those intended or expected. A counter-puncher mentality, however, may minimize the value of planning based on best judgments about how the future will evolve.

Intuitors take advantage of the marvelous, not-well-understood capability of our brains to integrate vast amounts of information and varied experiences into a whole. Experiments have shown that certain individuals, typically successful executives, have better intuition than most others. However, excessive dependence on intuition may result in failure to pay appropriate attention to known information.

The challenge is not to determine which of these views is the "right one" or even the "best one." The challenge is how to use the Five Views of the Future framework to judge the validity of the forecast being assessed. In using this framework, the person doing the assessment applies the type of test that people using each of the views might employ.

For example, an *extrapolator* would probably ask the following questions:

- Are any trend data presented in the forecast?
- Are the driving forces that determine these trends analyzed?
- Is any consideration given to whether or not these driving forces will continue in the future?
- Are trends extrapolated for an unreasonably long time (i.e., beyond half the time that there is data supporting the trend)?
- Are natural limits on trends given appropriate consideration?

- Are different trends appropriately correlated?
- If the forecast presents a deviation from established trends, is adequate rationale presented to support the deviations?

A *pattern analyst* might assess the forecast by:

- Identifying at least three analogous situations from the past.
- Examining how the forecast future is similar to each of these situations.
- Examining how the forecast future is different from each of these situations.
- Determining if repeating patterns of events can be identified.

A *goal analyst* might test the forecast by asking the following questions:

- Have the people who have stakes in the evolution of the forecast been identified, and have the nature and impact of their probable actions been properly analyzed?
- Have various societal, environmental, market, and similar factors been given adequate consideration?
- Is there an identifiable source of prejudice embedded in the forecast (i.e., is the forecaster trying to use the forecast to achieve his or her personal ends)?

- A *counter-puncher* would probably test the forecast by asking the following questions:

- Which feasible events might significantly impact the forecast?
- Has proper accord been afforded such events?
- Does the forecast provide the basis for an effective surveillance plan?
- Is any type of probability assigned to the significant factors in the forecast?

An *intuitor's* analysis might address the following issues:

- Are assumptions involved in the forecast clearly specified, and are these assumptions reasonable?
- Is there an evident path of logic embedded in the forecast?
- Does the forecast provide a basis for rational discussion?

Applying the Principles

In the previous paragraphs, we have suggested how managers and executives can test forecasts both for inaccurate or inappropriate data and for the application of inappropriate forecasting models. Failure to intelligently test business, financial and technology forecasts can, obviously, result in very unfortunate outcomes. Such a failure, together with the reasons for and results of the failure, are demonstrated in the following example.

Good decisions based on poor forecasts are rare indeed.

A recent and financially painful lesson in the importance of quality analysis and forecasting came with the telecom industry collapse in 2000. Contributing factors to the over-exuberance that led to the collapse were widely-publicized statistics and forecasts of the growth in Internet bandwidth. Appearing in the 1998-99 timeframe, these held that Internet bandwidth was doubling "every 100 days" or "every 3 or 4 months" (*8*), equivalent to an annual growth rate in the neighborhood of 1,100 percent. Less fantastic, but still loaded with "gee whiz," were reports of doubling every six months, or 300 percent annually (*9*). Whether 300 or 1,100 percent, these forecasts were used to justify the investment of billions in new fiber-optic construction. Unfortunately for the investors, they were wrong. Actual Internet bandwidth growth has been closer to 100 percent annually, still healthy, but not enough to keep the bubble from bursting (*10*).

At least two factors were behind the overly-optimistic projections. First, there was poor analysis of the historical growth rate. Individual Internet service providers might experience an extremely rapid growth spurt and in the early days of the Internet the growth rate was extraordinary. But average growth rates across the Internet and over the 1990s were more average.

Second, there was poor understanding of the underlying fundamental dynamics of growth. The forecasts assumed an exponential model with an extraordinarily high growth rate continuing into the future—"Moore's law on steroids" was the quip. However, the high growth rate was fueled by millions of new Internet users coming on line in the 1990s. Internet adoption was following a classical S–shaped curve, where the early growth rate is high, but falls off rapidly after the first 10 percent or so of the market is penetrated (*11*). Simultaneously, the bandwidth per user increased as people spent more time online and as their computers and applications grew more sophisticated. This factor, increasing roughly at the rate of Moore's law or about 57 percent annually, amplified the high early growth rate from new users. It also partially offset the inevitable fall-off in the growth

rate from new users, but not enough to sustain growth rates of 300 percent and more.

Were there good forecasts available in 1998 and 1999? Yes, and from very credible sources, but unlike the bad forecasts, you had to look for them. K. G. Coffman and Andrew Odlyzko of AT&T Labs published a careful analysis, concluding "the growth rate of traffic on the public Internet, while lower than often cited, is still about 100 percent per year, much higher than for traffic on other networks" (*12*). Network consultant Peter Sevcik put forth a slightly more aggressive view: "So, my best estimate is that . . . the total U.S. Internet has been doubling in demand every eight months and capacity every seven months. However, that's slowing down, and soon demand is likely to double every 11 months . . ." (*13*). Technology Futures combined the information from these sources with formal technology forecasting to conclude in 1999 that bandwidth would grow at 100 percent annually through 2010, with ups and downs during this period (*14*).

A distinguishing factor of the good forecasts was that their authors explained the basic processes behind the trend and were careful to use the correct data and technology forecasting models. This is a textbook lesson for forecasters. For consumers of forecasts, especially investors, the general lesson should be to look for quality and not pizzazz.

In Conclusion

Because of the importance of valid forecasts in effective planning and its execution, it can be very useful for decision-makers to have a systematic framework for assessing the forecasts of others. This paper outlined a framework for conducting such an assessment. It should be noted, however, that this framework can also be applied to forecasts developed by the decision-makers themselves.

Our experience has shown that most people have a propensity toward one of the Five Views of the Future described in this paper. Although there are certainly exceptions, we have found that, in general, engineers tend to be extrapolators; pure scientists tend to be pattern analysts; and marketing people tend to be goal analysts. Executives tend to rate themselves primarily as counterpunchers, although, in reality, most are probably primarily intuitors (*15*). Thus, once people determine their natural inclination, they are well advised to emphasize the tests associated with other viewpoints.

It is also worth noting that, in conducting the listed tests, executives may not only gain or lose confidence in a given forecast, but they may also discover information, insights and concepts beyond those actually addressed in the forecast itself.

Finally, it must be pointed out that a valid forecast is only one element of a proper decision. Many very bad decisions have been based on very good forecasts. However, good decisions based on poor forecasts are rare indeed.

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10. To put this in perspective, with an 1,100% growth rate, in three years bandwidth would expand by a factor of 1,000. With a 100% rate, it would expand by a factor of 8.

11. In the early years, absolute additions remain relatively low, but the growth rate is high because growth is coming off a small base.

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15. These observations are based on informal polls conducted by the authors at more than 60 presentations of the "Five Views of the Future" concept before various professional groups.