Technology Forecasting in Healthcare
and the wisdom of crowds

The 6th Annual Sensors in Medicine 2019 conference will incorporate a forecast of sensor technology in healthcare. This paper looks at some basics of technology forecasting.

Several decades ago, I enrolled in a one-year accelerated Master's program known as the AMP at MIT's Sloan School of Management; it was essentially a two year MBA program squashed into twelve months. At that time, MIT didn't award MBA's so we all ended up with SM's: Master of Science in Management.

As we sweated over a long hot summer and became accustomed to very little sleep, one of the less demanding activities was a weekly seminar in which some of the leading faculty of the Sloan School explained to us what their speciality was, and why it was so important. In hindsight, I suspect the objective was to recruit free pairs of hands for their research activities. We were required to write a thesis on some original piece of work under the guidance of a faculty member, which occasionally would lead to a published paper.

One of the distinguished faculty who talked to us was Prof. Ed Roberts, who held at least 3 MIT degrees and was internationally known for his work on technology management, besides running his own consulting company on the side. I wanted to have Prof. Roberts as my thesis supervisor, and in the Q&A session which followed his talk, I ask if Sloan taught technology forecasting. "No," he replied, "It's rather passé."

Ed did in fact agree to be my thesis supervisor, so it would be churlish of me to suggest that his lack of interest in technology forecasting was in any way related to the fact that the then leading authority on the topic was James Bright, a professor at Harvard Business School, across the Charles River, a more or less friendly competitor of Sloan.

Interest in technology forecasting continues to be alive and well, and has been legitimised with its own journal, "Technology Forecasting and Social Change" (Elsevier), which tends to be about methodology rather than reporting forecasts. Futurism has become a more popular discipline for looking ahead, and is not limited to technology; social change is a popular topic for forecasting. This activty too is now legitimised through the Association of Professional Futurists.

Technology Forecasting advocates like the National Research Council claim a large number of different methods to achieve realistic forecasts, but Martino (2018) suggest four basic approaches. Each of them requires the collection of data prior to making the forecast, but in each case expert opinion will play a part. Claims of academic rigour in forecasting are hyperbole - the forecast will only be as good as the opinions of the experts on which it is based. Surowiecki (2004) in the Wisdom of Crowds argues for the collected aggregate opinon of a knowledgeable group is more likley to be correct than that of any one individual.

Methodology

In this paper we look at four basic forecasting methodolgies, and we will see how group forecasts can influence the forecast.

Judgemental and Intuitive Methods

It is an easy trap to rely on expert forecasts and it must be admitted that there are forecasting practitioners who exploit a plausible expertise. However, expert guesses about the future may be no more likely to be accurate than those less expert.

This is a good place to introduce two approaches which can soften the expert view:

Demand Forecasting bases its predictons of what is needed - market pull vs the prevalent technology push in biosensor research. For example, cardiovascular, neuropsychiatric and malignant disease are far more prevalent than diabetes, which is currently the leading biosensor health application.

Delphi methods are based directly on the wisdom of crowds. A (large) group of experts are asked to make predictions on the future of a technology. The results are likely to cluster, with some outliers. Predictors of out-of-mainstream outcomes are invited to explain their rationale which is then fed back to the expert group, who can revise their forecast. After two or more rounds, a reasonable set of predictions will result, unbiased by the views of individual experts.

Trend Forecasts

Perhaps the best-known technology forecast is Moore's Law, which in 1965 predicted that the number of transistors on a silicon chip would double every year. It has held true until around 2010, when it has been suggested that deviations are starting to occur.
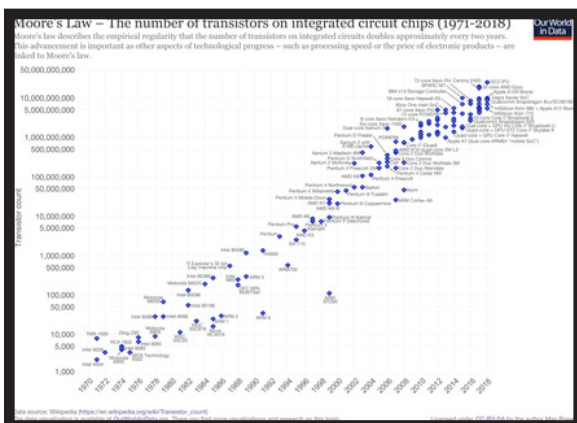
*Moore's Law Plot Reproduced from Wikipedia*
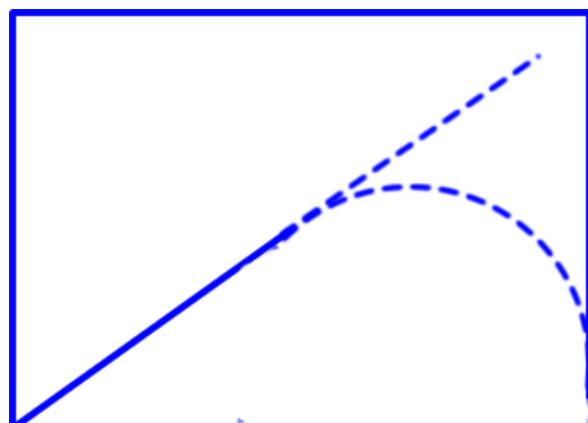

When do trend forecasts go wrong?

The chief difficult with trend forecasts, assuming a quantifiable trend vector can be identified, is knowing what happens beyond the exisiting data set - does the trend continue or is there a lurking "Black Swan" event. Expert opinion will have views on this eventuality.

Modelling

Building models for the development of new products is a fairly standard process and is not normally considered to be "technology forecasting". However such models can extend out for ten or more years and can include the introduction of competitors as well as Black Swan events.
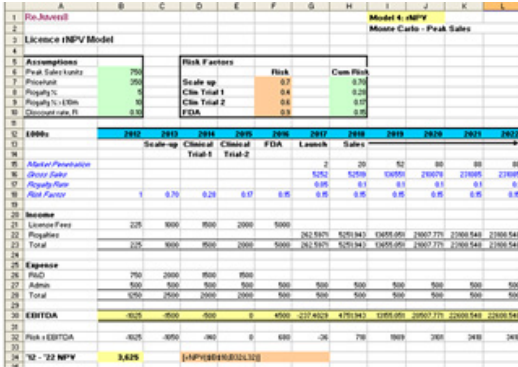
*Spreadsheet model for development of a new product over a ten year period*
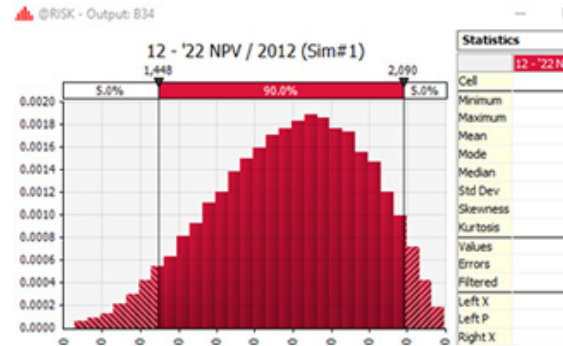
Histogram of model predictions of NPV

These kind of models depend on realistic assessment of the probability of events, such as a successful scale up or gaining FDA approval. For drug development, these probabilities are fairly well established, based on many trials. For medical device developments, expert opinon is the best that can be used. Monte Carlo simulation provides insight as to the likely success or otherwise of the new product.

Scenario Forecasting

Scenario models paint a picture of a possible future, based on an undertanding of the past and present, often in a qualitative way. It is possible to build up a set of feasible future scenarios, and voting systems are used to assess the probability of any one occurring. This approach offers great scope for creativity in developing scenarios -this is where the science fiction ideas appear, While these ideas may be tempting, in making realistic forecasts it is probably better to keep to more feasible scenarios.
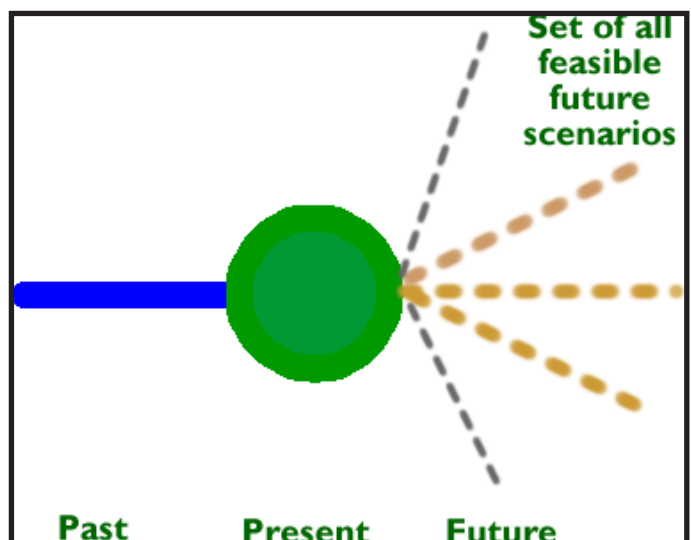
What is Happening at [Sensors in Medicine 2019](#)?

The Sensors in Medicine conference series attracts a mixed audience of academic researchers, industry and clinicians, all knowledgeable about sensor applications in healthcare. It is proposed to use this audience to vote on several scenarios on the use of sensors in healthcare. It is hoped that the outcome can be used to direct the future development of sensor application in healthcare.

Sensor100, which organises the Sensors in Medicine conference series, has a database of several thousand people active in sensor technology. This is a resource which could have value in predicting where the future lies for sensor technology in healthcare. As a first step, we will run an on-line survey of these experts to get a view of which emerging sensor technologies they believe will have most impact on healthcare in the future.

References

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2.   Persistent Forecasting of Disruptive Technologies
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      Joseph P Martino (2018)
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