

# METHODS TO ELICIT FORECASTS FROM GROUPS

## DELPHI AND PREDICTION MARKETS COMPARED

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### PREVIEW

**The Delphi technique is better than traditional group meetings for forecasting and has some advantages over another promising alternative to meetings, prediction markets. In this article, Kesten, Scott, and Andreas observe the increasing popularity of Delphi, describe the benefits of using this method to obtain forecasts from experts, compare it with prediction markets, and conclude that Delphi should be used more widely.**

### INTRODUCTION

**M**uch can be done to improve upon traditional group meetings. As Armstrong (2006) showed, it is difficult to think of a structured approach (e.g., Delphi, virtual groups, prediction markets) that would not improve on the predictions and decisions made in traditional meetings.

Gene Rowe's article in this issue of *Foresight* (pp. 11-16) presents evidence that, in comparison with traditional meetings, the Delphi technique can improve forecasting and decision making. How does it do that? If conducted properly, Delphi greatly improves the chances of obtaining unbiased esti-

### KEY POINTS

- As structured alternatives to group meetings, Delphi and prediction markets can improve organizational efficiency and effectiveness.
- Delphi can be conducted relatively cheaply and can be used to speed up, as well as to replace meetings.
- Freeware is available at [forecastingprinciples.com](http://forecastingprinciples.com) to help you implement a Delphi process.
- Delphi can be applied to a greater variety of problems and is easier to use than prediction markets.

mates and forecasts that take full account of the knowledge and judgment of experts. Delphi is also more convenient and versatile than a third method for aggregating individual judgments: prediction markets.

We consider that, half a century after its original development, Delphi is greatly underutilized.



Kesten Green is a Senior Research Fellow of the Business and Economic Forecasting Unit, Monash University, Co-Director of [forecastingprinciples.com](http://forecastingprinciples.com), and Managing Director of Decision Research Ltd. He has published in the *International Journal of Forecasting*, *Interfaces*, *International Journal of Business*, and *Foresight*. In recent years, he has been researching the problem of how best to predict the decisions people will make in conflict situations. His first paper on the topic was awarded Best Paper for 2002-2003 by the International Institute of Forecasters. Kesten has become concerned that major government policies are based on poor forecasts, in particular forecasts of global warming. His audit of climate forecasting methods with Scott Armstrong will be published later in 2007 in *Energy and Environment*. Prior to his academic career, Kesten spent more than twenty years in business as a founder of four companies.



J. Scott Armstrong, Professor of Marketing at the Wharton School, University of Pennsylvania, was a founder of the *Journal of Forecasting*, *International Journal of Forecasting*, and International Symposium on Forecasting. He is the creator of [forecastingprinciples.com](http://forecastingprinciples.com) and editor of *Principles of Forecasting* (Kluwer, 2001), an evidence-based summary of knowledge on forecasting. In 1996, he was selected as one of the first six Honorary Fellows by the International Institute of Forecasters. Along with Philip Kotler and Gerald Zaltman, he was named the Society of Marketing Advances' Distinguished Marketing Scholar of 2000. For the past 13 years, he has been writing *Persuasive Advertising: An Evidence-Based Approach*, which he forecasts will appear in 2008, or 2009, who knows.



Andreas Graefe is a research associate at the Institute for Technology Assessment and Systems Analysis at the Research Center (Forschungszentrum) Karlsruhe, Germany. He holds a diploma (German equivalent to a master's degree) in Economics as well as a diploma in Information Science. In his PhD thesis, Andreas is researching the applicability of prediction markets for long-term forecasting problems, in particular by comparing them to the Delphi method.

## HOW DELPHI HAS BEEN USED

The Delphi procedure has been around since the late 1950s. To assess its use, we conducted a Google search for “Delphi AND (predict OR forecast).” This yielded 805 unique sites out of a total of 1.4 million, showing that some people have paid attention.

Using the same keywords, we conducted searches in the Social Sciences Citation Index and the Science Citation Index Expanded to assess what has been happening to researcher interest in Delphi over the years. We identified altogether 65 relevant items: 1 from the 1960s, 8 from the 1970s, 3 from the 1980s, 21 from the 1990s, and 32 so far this decade.

When we searched for “Delphi forecast of” and “Delphi forecasts of,” we found 42 unique applications of the Delphi technique. The largest number of them (43%) were business applications. These included forecasts for:

- the Argentine power sector
- broadband connections
- dry bulk shipping
- leisure pursuits in Singapore
- rubber processing
- Irish specialty foods and
- oil prices.

Forecasts of technology were also popular (36%); these included forecasts about intelligent-vehicle highway systems, industrial robots, intelligent internet, and technology in education. Finally, 21% of applications were concerned with broader social issues such as the urban future of Nanaimo in British Columbia and the future of law enforcement.

We also found nearly 4,000 unique items using a Google Scholar search for the single word Delphi in titles. This suggests that the technique is used more widely than just for forecasting.

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We have ourselves employed Delphi for problems like forecasting prisoner numbers, choosing between regional development options, predicting outcomes of political elections, deciding which applicants should be hired for academic positions, and predicting how many meals to order at conference luncheons.

## HOW DELPHI MIGHT BE USED

Delphi can be used for nearly any problem involving forecasting, estimation, or decision making – as long as complexity and ignorance do not preclude the use of expert judgment. In short, it could be used to replace most face-to-face meetings other than those involving negotiations or selling.

The issue of ignorance is important. If the individuals in a group are misinformed about a topic, the use of Delphi will, as in a traditional group meeting, only add confidence to their ignorance. However, uncovering disparity among the experts might help to alert decision makers to this problem. For example, in a Delphi study of economic growth, most participants believed that support for higher education was a positive factor, while a small minority claimed it was negative. This issue should have been decided by reference to the research literature rather than by asking experts.

People are not good at thinking through complex situations, such as those that involve several rounds of interactions with others. Green and Armstrong (2007) showed that unaided experts are unable to provide valid forecasts about the outcomes of negotiations and other conflict situations. The Delphi process cannot improve forecasts when the individual panelists are incapable of providing valid forecasts.

With Delphi, experts are asked to provide reasons for their forecasts and to respond to the predictions and justifications given by the other experts. In our experience, this record of argumentation among experts is attractive to those clients who are skeptical of forecasts from a statistical model. Hoffmann et al. (2007) observed that the findings of their survey of expert opinions on the distribution of food-borne illnesses in the U.S. were met with skepticism until their audiences saw the list of expert participants.

Gene Rowe’s paper indicates that Delphi can be expensive, but is it expensive in comparison with traditional group meetings? We like the taxi-meter solution to meetings: each person attending a meeting enters a billing rate into a computer and the computer shows the mounting cost as the meeting grinds on.

When high expert status is not needed to help sell the forecasts, only modest expertise is required. This means that expenses can be kept low and that forecasts can be made rapidly.

Freeware for conducting Delphi sessions is available at [forecastingprinciples.com](http://forecastingprinciples.com) (under Software). When the forecast question is clear and panelists are cooperative, the software helps the administrator to complete a session in quick time. The software is used to compile questions, store a list of potential panelists and their e-mail addresses, send appeals to panelists, and compile responses. The software also provides guidance on how to use Delphi. The directors of [forecastingprinciples.com](http://forecastingprinciples.com) continue to increase the flexibility of the Delphi software to allow greater customization.

One way to reduce the cost of traditional group meetings is to use Delphi procedures within the meeting, a process known as *Mini-Delphi* or *estimate-talk-estimate*. This also helps to ensure that people provide their estimates during the meeting. To further speed up traditional meetings, Gordon and Pease (2006) developed *Real-Time Delphi*, a web-based approach that automatically aggregates participants' judgments and allows them to reassess their positions. Real-Time Delphi appears promising, but it has not yet been evaluated.

### DELPHI VS. PREDICTION MARKETS

In recent years, there has been a resurgence of interest in prediction markets, which were quite popular in the late-1800s and early-1900s (Rhode & Strumpf, 2004). In her *Business Week* article, King (2006) claimed that at least 25 companies had started to experiment with prediction markets. The forecasts have proven to be accurate in limited tests to date. An internal market at Hewlett-Packard on future product sales, for example, beat the official forecasts of the company in 6 out of 8 events (Chen & Plott, 2002). Researchers are also doing more in this area, and in response to this interest the *Journal of Prediction Markets* was launched in 2007.

Prediction markets are similar to Delphi in that they are both methods for aggregating diverse opinions. Little is known about the relative accuracy of forecasts from the two approaches, although both do much better than unstructured group meetings.

Participants in prediction markets buy and sell contracts. These contracts promise a payoff if an event occurs. In their entry on prediction markets for the *New Palgrave Dictionary of Economics* (2<sup>nd</sup> ed.), Wolfers and Zitzewitz (2006) provide a useful summary of the method. They tabulated three

different types of contracts: binary options, index futures, and spread betting. Each is designed to provide a different kind of forecast. In the case of a binary option market, the price at which a contract most recently traded (or an average of the most recent prices) is interpreted as the market's assessment of the probability that the event will occur. For example, suppose a contract will pay \$1 in the event that Britain withdraws more than 50% of her troops from Iraq before the end of 2007 and nothing if Britain does not. If the contract last traded at 22 cents, the market's assessment is that the likelihood of that withdrawal event is 0.22.

Prediction markets have a number of advantages over traditional meetings:

- Participants are motivated by the anticipation of profit to reveal their true beliefs and to participate over a long period of time.
- Markets can be run continuously and thereby instantly and automatically incorporate new information into the forecast.
- Participants themselves choose to take part if they think that their private information helps them derive a better forecast than the one that is implied by the current market price.

Using a prediction market typically requires that the situation's outcome will eventually be known. Without a clear outcome, such as the percentage of votes gained by a candidate, the sales figures for a given time period, or the annual growth in GDP, participants could not be appropriately rewarded or punished. Little is known about how well prediction markets perform for events whose outcomes may potentially not be known or cannot be clearly determined at all. Furthermore, events that have long time horizons pose problems, as participants may have to wait for years until their payoff can be determined.

Delphi has these advantages over prediction markets:

- [1] It can be used for a much broader range of problems, since there is no need to judge the outcome of a situation in order to determine payoffs for participants.
- [2] Many people lack the understanding of how markets work or how to translate their expectations into market prices. It is easier for people to reveal their opinions in Delphi.
- [3] It can be challenging, if not impossible, to formulate some problems as contracts in prediction markets. It is easier

to address complex issues and to obtain predictions by asking direct questions of a Delphi panel.

[4] It is easier to maintain confidentiality with Delphi. For markets, it may be morally objectionable to benefit from trading on the outcome of critical issues. For example, the policy analysis market set up by the DARPA to predict events like regime changes in the Middle East or the likelihood of terrorist attacks was cancelled one day after it was announced (Looney, 2004). Concerns may also arise over the use of markets within businesses, for example to decide whom to hire or fire, or where the forecast may demotivate participants who are also employees of the business.

[5] Prediction markets are vulnerable to speculative attacks mounted in order to manipulate the results. A Delphi administrator, on the other hand, can choose panelists who are likely to reveal their true beliefs and exclude extreme values from the calculation of the Delphi forecast either directly or by calculating a median rather than a mean.

[6] The opportunity to provide comments or reasons for judgments allows Delphi participants to introduce new ideas into the discussion. And the transparent exchange of knowledge allows experts to learn while participating in the Delphi process.

[7] Such an exchange also reveals information that has already been taken into account. This helps Delphi panels avoid two undesirable features of predictions markets: the inefficiency of each participant independently searching for information and the occurrence of *cascades*. A cascade is a cumulative and excessive price movement that occurs when some participants, assuming that a shift in price is due to new information, react, leading others to react to the reactions.

[8] Delphi requires only 5 to 20 experts who have agreed to participate and should therefore be superior to thin markets (those with few participants) where the incentive to trade, and thereby reveal information, is weak (Abramowicz, 2004).

## CONCLUSIONS

In sum, we believe that Delphi should be much more widely used than it is today. It should replace many traditional meetings. Provided that it does not drive out other valid structured methods, it is unlikely to cause harm and will likely improve forecasting and decision making – and thus increase the efficiency and effectiveness of your organization.

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