Should Probabilities Be Used with Scenarios?

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Abstract

It has been long argued that all scenarios should represent possible, not likely, futures and should not be assigned any probabilities. One argument is that the scenario team and managers should consider all the scenarios as equally likely and to prepare for each scenario. In addition, the strategic purpose of scenarios is to think of alternative futures and get away from financial and other types of time-series trend forecasts. On the other hand, there is a counter-argument that says that probabilities can and should be used with scenarios. These probabilities, however, are Bayesian in that they explicitly include assumptions, imagination, and expert judgment and that they go beyond trend projections. This paper reviews both arguments and makes recommendations as to when probabilities are appropriate for scenarios and when they are not.

Keywords: scenarios, scenario analysis, probabilities, futuring, foresight, strategic planning

Introduction

A persistent controversy among practitioners is whether probabilities should ever be assigned to scenarios. The first generation of scenario planners at Shell, SRI International, and GBN was adamant that probabilities should never be used with scenarios. But with whom were they arguing? Very few scenario analysts have employed either cross-impact analysis or probabilities to generate scenarios as forecasts of alternative futures in comparison with the dominating intuitive scenario writing approach. The practitioners of intuitive scenarios have been largely successful in convincing subsequent generations of scenario planners that probabilities cannot be used with scenarios – yet the argument has been hardly closed.

This paper will review the debate over the use of probabilities with scenarios and conclude by making some recommendations for future practitioners. In the process, some of the history of scenario generation provides insights into the nature of concern about probabilities.

The Origins of Scenario Planning

The use of scenarios as a tool for planning originated with Herman Kahn and his associates at the RAND Corporation in the 1950s. By showing alternative paths to a nuclear war with the Soviets, Kahn convinced the U.S. Air Force that different sequences of events could result in numerous possible outcomes, some of which were desirable and some were not. Kahn's scenarios were hypothetical sequences of events, much like a play or movie plot synopsis, which was the traditional meaning of "scenario." His scenarios were also mental models much like imaginary war games. Kahn consistently stressed that his scenarios were strictly hypothetical and not predictive – they were possible outcomes as a tool of planning and not forecasts of the future. Therefore, Kahn had no use for probabilities in his scenarios (Kahn, 1962, pp.150-185).

After Kahn established his own Hudson Institute in the 1960s, he was approached by two corporate planners who wished to explore whether scenarios might be applied to business as well as military planning. One was Ian Wilson from General Electric (GE); the other was Pierre Wack of Royal Dutch Shell. Both GE and Shell, although very different kinds of multi-national corporations, faced similar business uncertainties in the 1970s. Wilson's maiden scenario project was completed first, but Wack was the one who made corporate scenario planning famous at Shell in 1972. Both Wilson and Wack changed the fundamental definition of a scenario from Kahn's hypothetical sequence of events from the present to the future to alternative future states regardless of the steps by which they were achieved. Wilson's team generated four alternative futures for the U.S. domestic consumer market by 1980, while Wack's team generated two alternative futures for international oil to the year 2000. Wilson's team applied intuitive probabilities to their GE scenarios, but Wack's team did not (Bradfield, Wright, Burt, Cairns & van der, 2005; Kleiner, 2003; Millett, 2003; Wack, 1985a & 1985b; Wilson, 1971)

Wack was insistent that probabilities should not be used with scenarios. He agreed with Kahn that scenarios, even defined as alternative outcomes rather than paths, were purely conjectural. Wack and his Shell team were every bit the oil experts, with years of research and analytical experience, as Kahn and his RAND colleagues had been defense experts. Both Wack and Kahn meant to stimulate senior management thinking about the future, not to provide forecasts of the most likely futures. They wanted to encourage flexible rather than deterministic planning. Furthermore, Wack intended to use scenarios at Shell as alternatives to financial and statistical forecasts that he believed had become the opiate of corporate strategy. He wanted to move toward interpretative stories, not hard numbers, so probabilities could not be used with the scenarios because they looked too much like forecasts.

In the meanwhile, Wack resumed his relationship with Wilson, who joined the corporate planning consulting group at SRI International. Wilson abandoned the use of probabilities and adapted to Wack's approach. The Shell and SRI International scenario planners worked so closely that years later they argued over who had actually originated the scenario method.[1]

The legacy of Wack largely fell to an SRI International analyst, Peter Schwartz, who learned the scenario method first at SRI International and then at the Shell corpo-

rate offices in London in the early 1980s. Schwartz and his closest associates, both American and British, in 1988 formed their own company, Global Business Network (GBN) back in the San Francisco Bay area. While Wack wrote the first case history of the Shell scenarios in two articles for the *Harvard Business Review*, Schwartz wrote the first book on the subject, the *Art of the Long View*, which became the bible of most scenario practitioners ever since. A friend of the movie director Steven Spielberg since high school, Schwartz had a charismatic flair for the dramatic, giving scenarios a strong dose of the entertaining rather than the hard analytics of the early Shell approach. If Kahn gave scenarios its catastrophic military importance and if Wilson and Wack gave them their earnest business tone, then Schwartz gave scenarios their joyous and exciting flavor in the otherwise dour world of corporate planning (Schwartz, 1991 & 2008).

Arguments Against the Use of Probabilities

The Shell, SRI International, and GBN scenario practitioners have continued the traditions of Kahn and Wack and strongly opposed the use of probabilities with scenarios. For the last 35 years or so, they have objected to the use of probabilities for the following reasons:

- Scenarios should be used for identifying possible and preferred futures, not likely futures. As a planning tool, scenarios should expose many possible outcomes in the future and not just one, which is an inherent danger of using probabilities that make plausible scenarios look like predictive scenarios. In reaction to the corporate over-reliance on quantitative forecasting, especially linear projections of the past to the future, all scenarios should be considered equally likely so that plans will be developed for each scenario. Sometimes the least likely scenarios are the most opportune or threatening and they more attention than any "most likely" scenarios.
- The use of probabilities implies too much precision and distracts from the storytelling qualities of scenarios – probabilities look like numbers and therefore assume too much precision and the presumption of predictive accuracy. Scenarios are most powerful when they stimulate flexible and innovative thinking about the future. Some have gone so far as to assert that the greatest value of scenarios is to "learn" from the future, or to use scenarios as a teaching tool. Probabilities only obscure the compelling logic and strategic implications of scenarios for senior managers.[2]
- Forecasts may capture trends, but they cannot capture the discontinuities of change that come from intuition, imagination, and the story qualities of scenarios. As many are quick to assert, "You can't predict the future." The uncertainties of the future are better addressed by multiple and equally plausible scenarios rather than either traditional quantitative forecasts or single "most likely" scenarios.
- Scenarios should be generated by teams, thereby bonding the members of a team together for the implementation as well as the generation of scenarios. Because teams have shown by experience that they can achieve consensus on plausible

scenarios but rarely can reach agreement on probabilities of occurrence, the use of probabilities compromises the team-building benefits (DeGeus, 1988, p.74; Fahey & Randall, 1998; Mandel & Wilson, 1993, pp.16-18; "Probabilities," 1991; Ralston & Wilson, 2006, pp.121 & 152-153; Schwartz, 1991; Wack, 1985a, pp.73-75) .

Cross-Impact Analysis and Bayesian Probabilities: Alternative Scenario Methods

Because of the successful marketing of intuitive scenarios by the alumni of Shell, SRI International, and GBN, many practitioners of scenario planning do not realize that systems methods were also developed to generate scenarios. For example, two of Kahn's colleagues at RAND devised cross-impact analysis as a quasi-quantitative approach to generating scenarios. One was Ted Gordon, who founded the Futures Group in Connecticut. He and his associates developed a method that they called trend impact analysis. The other was Olaf Helmer, who migrated from RAND to the School of Business at the University of Southern California (USC) in Los Angeles. He and his close associate, Selwyn Enzer, developed a computer-based cross-impact model to generate multiple scenarios as alternative futures (Duval, Fontela, & Gabus, 1975; The Futures Group, 1984 & 1985; Gordon, 1994; Huss & Honton, 1987; Millett, 2003).

In the 1970s, Enzer worked closely with the Geneva laboratory of the Battelle Memorial Institute to develop computer models using cross-impact analysis with Bayesian probabilities to generate scenarios. He was the agent of the cross-impact technology transfer from Helmer, RAND, and USC to Battelle. With multiple laboratories cooperating, Battelle developed its proprietary software program and scenario method called BASICS. In 1988 the mainframe version of BASICS was reprogrammed for MS-DOS on what we then called "micro-computers," aka personal computers. It was called BASICS-PC. The software program was once again reprogrammed in 1998 for Microsoft's Windows, with the revised method and software called Interactive Future Simulations (IFS)™. Well over 100 scenario projects for corporations and governments around the world were performed with the BASICS-PC and IFS.[3]

In brief, the Battelle approach to generating scenarios used as many as 24 descriptors (not just the primary two employed to create the structure, or two-by-two matrix, of intuitive scenarios). A descriptor was a trend, issue, or factor relevant to the topic question. Each descriptor had two to four alternative outcomes, or states, by a target year, and each state was assigned an *a priori* probability of occurrence. A matrix arrayed all descriptors and their states against all other descriptors and their states. Expert judgment was also used to assign cross-impact values to the cells of the matrix, and the algorithm then used the cross-impact values to adjust the *a priori* probabilities up to 1.0 (occur) or down to 0 (not occur). The software also organized the scenario clusters according to their frequency of occurring, so that there were resulting scenarios and most likely outcomes presented as *a posteriori* probabilities (Honton, Stacey, & Millett, 1985; Millett, 2008).

Bayesian probabilities can be used with scenarios both as a mechanism to generate them, as Battelle did, or as a group exercise to determine which scenarios appear to be more likely than others based on what we know today. *A priori* probabilities are always starting-place probabilities based on previous knowledge, intuition, and expectations. They are predicated on explicit conditions, which can be clustered as internally consistent sets of outcomes called "scenarios." Bayesian probabilities are continuously adjusted (*a posteriori*) according to new information up to the final moment of arrival at a target date in the future. Contrary to the supposition of some scenario practitioners, Bayesian probabilities are not inherently antithetical to the qualitative nature of intuitive scenarios and they are not based solely of statistical projections of past data to future points. (Malakoff, 1999; Mlodinow, 2008, pp.109-123; "Probabilities", 1991).

Furthermore, scenarios can be viewed as forecasts, if we broadly define forecasts as considered expectations for the future using methods that range from the highly qualitative to the strictly quantitative. They can have alternative outcomes as well as point projections in the future. All forecasts, especially scenarios, are conditional – they are based on both explicit and implicit assumptions, information about the past and present, and intuitive expectations for the future. Despite the rigors of mathematics, nobody has data from the future – but we do have expectations that can be expressed as Bayesian probabilities.

Arguments for the Use of Probabilities with Scenarios

Based on my own experience with more than 100 scenario projects, mostly using the analytical scenario method at Battelle and my own company, Futuring Associates LLC, the advantages for using probabilities with scenarios include:

- Although all scenarios should be treated equally, the reality is that they typically are not. Both scenario generating teams and executives gravitate toward the scenarios that they find to be "most interesting," which typically reflect corporate cultural biases and wishful thinking. The use of probabilities actually forces scenario teams and executives to examine likely scenarios that they might otherwise dismiss as plausible but not attractive.
- The use of Bayesian probabilities encourages people to explain their judgments, thereby exposing hidden assumptions, biases, and expectations that too often go unarticulated in the generation of purely intuitive scenarios. Probabilities demand more precision and explanation of underlying mental models behind the scenario stories. All scenarios are to one extent or another exercises in expert judgment; the use of probabilities drives people toward making those judgments explicit and subject to peer review and criticism.
- The array of scenarios according to their *a posteriori* probabilities of occurrence provides a map of both likely and desirable futures. There may be a distinct difference between the most likely (futuring) and the most desirable (visioning) scenarios. Analytical scenarios based on modeling, cross-impact analysis, and Bayesian probabilities allow teams and executives to better understand the conditionality of any scenario and determine what would have to happen to

improve the probability that the most desirable scenario could be made to happen. In other words, the use of probabilities facilitates strategy development by examining different conditions and their likely outcomes given different resource commitments (Millett, 2006).

- Models using cross-impact analysis and probabilities provide a tool for simulations of potential disruptive events and corporate strategies. Such simulations are very difficult if not impossible to perform with strictly intuitive scenarios. In addition, a systems approach with modeling and simulation is consistent with the tenants of Peter Senge and *The Fifth Discipline* (Senge, 2006).
- Probabilities are best guesses based on trend analysis, intuition, and expectations for the future that can be readily changed as new information becomes available or events occur. The tracking of probabilities goes hand in hand with the tracking of trends and provides a framework for continuously revising scenarios.
- The use of probabilities with scenarios facilitates their being used as different starting points for econometric and statistical forecasts. It also provides the basis for running different kinds of quantitative exercises, such as real options analysis.

Recommendations

The answer to the question posed as the title of this paper is "Yes, when..." Bayesian probabilities add much value to scenarios, but the successful use of scenarios to drive corporate planning for business success in the future depends very much upon corporate culture and politics. Fundamentally, if the use of probabilities with scenarios fits the corporate culture and stimulates creative thinking about alternative strategies under alternative conditions, then they should be used. Probabilities typically require more time, research, and thought than most intuitive scenario projects, especially workshops, provide. They may also require a laptop software program for modeling and simulation. Yet, there are other types of corporate cultures and circumstances when scenarios should be generated and used as prescribed by the practitioners of intuitive scenarios in the style of Shell, SRI International, and GBN.

In brief, probabilities can and should be used with scenarios in the following situations:

- Sufficient time, resources, and budget are present to do analytical scenarios with probabilities.
- The scenario team is familiar and comfortable with the concept of Bayesian probabilities.
- The corporate culture values quantitative and quasi-quantitative methods while it distrusts purely qualitative reasoning. This is particularly true for corporations or organizations with strong scientific and technological cultures.
- The cognitive style of corporate managers embraces the use of probabilities and appreciates both their strengths and limitations.

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Notes

1. Much of this information on the early history of scenario planning has come to me through numerous conversations with Ian Wilson and scenario planners from Shell. Ted Newland, who was Wack's principal associate at Shell, told me that the Shell scenarios were so bound by their experiences and expertise in oil that he did not see how the scenario method could be applied to other types of companies and businesses.
2. Napier Collyns, a veteran of scenario writing at Shell and an associate of Wack asserted that "But as Pierre [Wack] used to say, 'Any form of mechanical extrapolation/modeling/probability analysis is an enemy to thinking.' "Probabilities", 1991, p.12. This point of view would be strongly challenged by the advocates of modeling and systems thinking (Senge, 2006).
3. I joined the Battelle staff at the Columbus Laboratory in 1979 and conducted my first BASICS project in 1982. I participated in the worldwide Battelle BASICS team through the development of the BASICS-PC in 1985-1987 and I managed the re-programming of it into IFS in 1998. I conducted at least 100 small and large scenario projects for government and corporate clients around the world using the BASICS-PC and IFS methods and software programs.

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