The Futures Forecasting Engine (FFE): An Online Methodology for Anticipating Alternative Futures

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Introduction

This paper addresses the need for anticipating alternative futures and describes a methodology for doing so. First, it examines the foundations for forecasting and for describing problems in "inexact" environments. Second, it presents a specific three-stage methodology. This methodology contains multiple methods for creating and prioritizing future developments, harnessing expert opinion via a Futures Forecasting Engine (FFE) and the processing and interpretation of the created data. It is network-based (i.e. Internet/WWW), and is scalable from local to global in application. This generic, multi-method, methodology has been developed, tested and refined by the author. It is now available for use.

The Increasing Need for Anticipation and Feedforward Thinking

Over the last several decades, it has become apparent that we have entered a policy-making environment of increasing complexity, where rapid innovation will continue to "heighten policy uncertainty for everyone as technological trajectories become more difficult to predict... In order to minimize risks and maximize opportunities, policymakers will have to embrace rapid change and the attending continuous evolution of complex organizations as well as technologies" (Kash & Rycroft, 1994, p. 39). These factors heighten uncertainty about the future and the impact of policy decisions.

Despite needs for long-term planning, problems outside of a five-year timeframe are seldom detected and dealt with. Even when they are identified, they may not be sufficiently defined to generate the level of support necessary to ameliorate them. Or, they may be put aside pending the emergence of more data or to deal with other conditions that are deemed more urgent.

While uncertain, it is important to recognize that the future *does* emerge from past trends and current events. The vast majority of problems provide some form of advance warning years or decades in advance (Molitor, 1977). By scanning for the "weak signals" of the impending future, decision-makers "can identify key opportunities and threats ... in time to shape them to [their] advantage. This necessarily involves working with incomplete information – though it is the best available." (Renfro, 1994, p. 13).

Uncertainty about the future hinders effective decision-making. It is known from communication and information theory that uncertainties can be reduced by the collection or creation of information. It is also known that uncertainties create risks. Controlling risk and reducing uncertainties are not tied to the present; they often involve anticipating alternative futures and alternative actions.

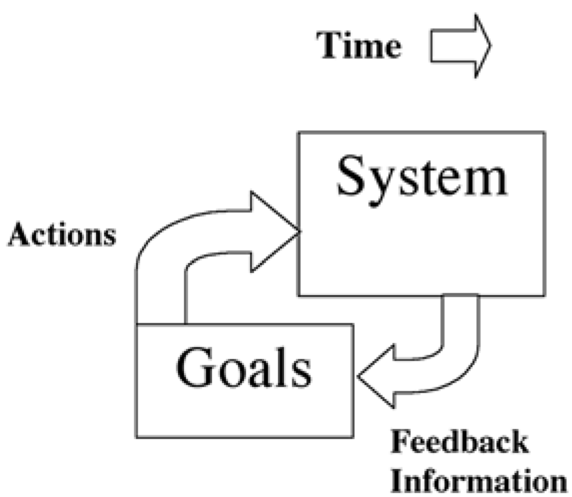
Communication, information and control are the foundations of cybernetics (Wiener, 1961). The cybernetics model arose from information and communication theory and seeks to identify the abstract principles and organization in biological or machine systems. Cybernetic systems are characterized by feedback loops, where information about the state of the system is compared with goals and actions (positive or negative) that are then cycled back into the system. Traditional cybernetic models work well in less dynamic situations. Past environments could be characterized as being relatively slow-changing, predominantly non-turbulent and offering moderately low risk. In the slowly changing environments of the past, waiting for feedback and subsequently applying control mechanisms was an effective strategy.

Emerging environments are often turbulent. Today, and increasingly in the future, we cannot afford to make decisions with a "rear-view mirror" mentality. A long-term view is needed to anticipate emerging problems while there is still adequate lead-time to analyze the situation and formulate strategies for problem reduction. In fact, "The costs of delaying actions on large, slowly emerging ... problems are very high... What is clear is that waiting for a state of crisis significantly increases both the costs and the timeframe for noticeable results once actions are necessary" (Wedemeyer, Ono & Winter, 2001).

A forecast study, conducted by this author (Wedemeyer, 1987), was done for the State of Hawaii. The study involved a fifteen (15) year forecast in which a number of event questions were presented to experts for two rounds of estimates. In this study, when asked to assess the event statement, "Successful terrorist attack on airline carrier bound for/leaving Hawaii", the experts estimated a 10% chance that the event would occur by 1988, a 50% chance that it would occur by 1992 and a 90% chance by the year 1996 (the "uncertainty range" for the 90% chance was 1994 to the year 2000). General analysis presented in the report about this event was as follows: "Seen as likely within next decade. Negative impact on tourism industry and Hawaii's economy as a whole. Signals need for diversifying economic base."

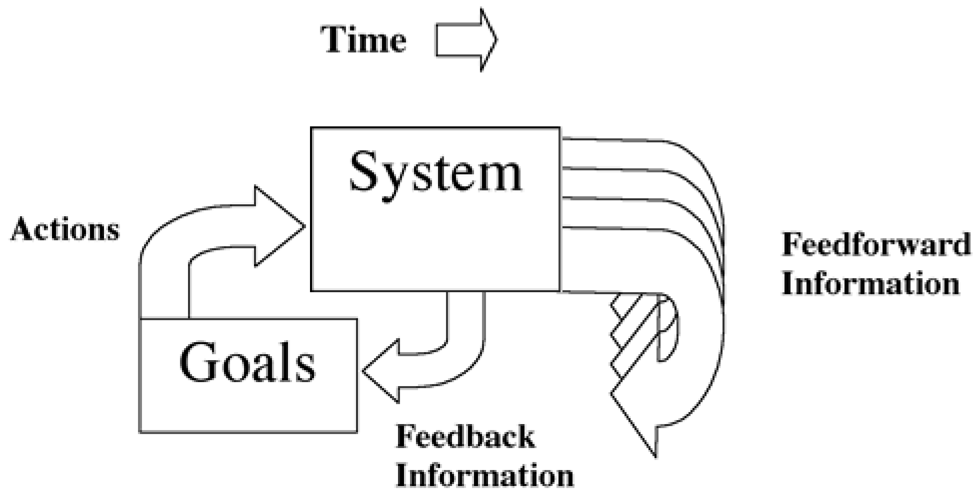
While the recent terroristic events of September 11, 2001 did not involve Hawaii in such a direct manner, they had strong economic impact. Had Hawaii established a diversified economic base in the fourteen (14) years between the forecast and these events, the negative economic impacts would probably have been significantly reduced.

Accelerating rates of change and added layers of complexities make the task of anticipating alternatives futures difficult. None-the-less, anticipating key developments are central to medium and long-term survival. Alternative, "if-then", "feedforward" conditions have to be anticipated. Having done so, they are combined with associated actions. This affords adequate lead-time to maximize the possibilities of successful decision making. Consider the following:



Traditional cybernetic model

Contrast this with an adapted/modified model, which incorporates the notion of anticipatory information in the information and control loop



Feedforward information in the modified cybernetic model

In this modified cybernetic model, the "System" represents the complete environment, including social, economic, political and technical components. "Goals" represent the *desired* outcome of planning and policy choices, and "Actions" are those steps taken to bring the System and Goals into closer alignment. An important distinction in this model is that information takes two forms, feedback and feedforward. Depending upon the states of the information as compared with the goals, different actions are called for. This tends to reduce uncertainty and increase more timely states of system equilibrium brought about in the control processes (e.g. immediate actions or longer-term policy making and/or planning). With adequate resources, feedback information is relatively easy to obtain and interpret. Feedforward information, the subject of this paper, is not.

The Foundations for Forecasting

Forecasting seeks to anticipate the future in an effort to reduce the domain of the unknown. It involves the process of examining alternative courses of action and the probable outcome of pursuing various alternatives in terms of costs and risks so that a desirable choice can be made from among them. In reality, policy and planning decisions are seldom made with certainty. There is seldom reliable data about the future, and it probably cannot be adequately forecast through extrapolation of current trends. Systematic forecasting and futures research are therefore embedded in the "inexact sciences", those that rely on subjective human judgment (Helmer, 1983). The opinion of experts, those who have extensive explicit and implicit knowledge about a particular domain, is used as a *source* of data about the future.

Forecasting methods strive for effective application to real-world social problems (Helmer, 1983). We cannot, and need not, have extensive knowledge of the future. By limiting the forecast time range or scope, or by simplifying the complex environment by modeling the system or representing it in more abstract terms, useful information for decision-making is generated. Any reduction in uncertainty is significant, as it may reveal critical leverage points within a system; it may also reveal situations that are *resistant* to intervention (Axelrod & Cohen, 1999).

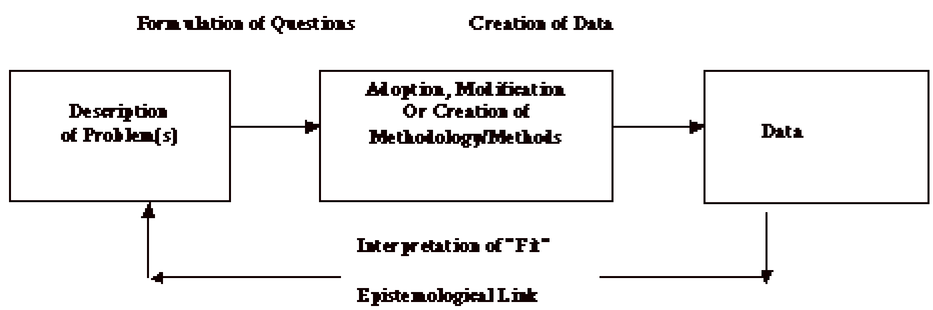
Methods using expert probability assessments have been used for some time (e.g. Gordon & Helmer, 1964; Helmer, 1983; Wedemeyer, 1978). It is the premise of this paper that existing methods have to be modified and that new methodologies and methods have to be invented, refined and advanced. New theories addressing the dynamic nature of complex socio-technical systems – e.g. complex adaptive systems (Linstone, 1999), chaos theory (Gleick, 1987), catastrophe theory (Thom, 1975), and fuzzy logic (Kosko, 1993) – need to be incorporated into ways of thinking about (and investigating) alternative futures or slowly emerging, long term, problems (Wedemeyer, Ono & Winter, 2001).

Defining vs. Describing Problems

Traditional research requires defining a problem in a relatively precise manner before it may be scientifically investigated. In contrast, complex societal problems occur in the "real world" and cannot be easily defined or contained. They are typically ill-structured with uncertain boundaries and part of complex systems characterized by dynamic interactions (Linstone, 1999). Thus many of our current or emerging problems can, at best, be characterized as "fuzzy" in nature. There is often uncertainty about their beginning, development and end or there is incomplete, or unavailable, data about the problem (DeTombe, 1994). Problem definition may be further confounded by the assumption that a problem either exists or it does not. There may be a lack of consensus as to when it has crossed the border between "non-issue" and "problem". These characteristics by no means reduce their importance, but it does make investigation and problem reduction more difficult.

In addition to being ill-structured, complex and interdisciplinary, problems are particularly difficult to assess because they are often highly interconnected to other second-, third- and fourth-order future problems. While a problem may initially appear unique, it may actually be part of a "problem network", influencing additional problems in other spheres or locations. The complexity of these problem networks indicates that a problem deemed most important may actually be reinforced by other, less visible, problems. Therefore, the human and financial resources allocated to address the problem may not be effective, or could potentially even exacerbate the problem. Developing an understanding of the extent and magnitude of these interdependencies is essential, as any results in reducing critical ones promises to have positive effects elsewhere.

Traditional analytical methods are not suitable for addressing ill-defined and emerging problems that have little or no data about them. Clearly, this condition calls for a very different approach. A futures research approach is suitable in these situations because it often seeks to describe a problem to the extent that it can.



Research Approach to Ill-Structured Problems

When one is able to describe an emerging problem in sufficient detail, the "pattern" of the problem becomes recognizable and subsequently addressable. A second characteristic is a general agreement that if the "less than precise" problem description were in fact the case, then most would agree that a problem(s) exists and non-traditional investigative tools are necessary.

These conditions make it complicated to pose appropriate research questions. It is accepted that any new or modified methodology must first address how one asks the appropriate questions. Once satisfied, the creation of data around these questions would be achievable. Finally, the epistemological link between the descriptions of the problems and the data would have to be addressed in the interpretation and analysis.

Approaches to Forecasting

Many traditional forecasting tools (e.g. extrapolation, model building, etc.) are based on past rules and existing trends and are ill-suited to times of unique and/or rapid change or for time frames beyond five years. What seems to be more appropriate is to identify critical developments and project their probabilities, projected rates of change, imbalances, gaps and other critical factors. Analysis may reveal a basis for determining where and when critical leverage points within the complex system can be exploited to reduce uncertainty (Linstone, 1999; Wedemeyer, Ono & Winter, 2001).

A combination of methods, i.e. a multi-method approach, is often used to improve reliability and quality of the results. The appropriate combination is established once a problem description or set of topic foci is selected. One suggested methodology involves a cycle of methods starting (or ending) with a set of data-based scenarios. This process posits a number of unanswered questions or assumptions that can be used to generate future problems or possibilities. Not all of these can be addressed, so it is important to narrow the field to a manageable number of key developments. A single or iterative survey can be used to rank-order their importance, and these developments can then be assessed via traditional or modified Delphi methods.

Delphi is a structured group communication technique that organizes and utilizes expert opinion in order to deal with complex problems (Wedemeyer, 1985). While this is a well-tested technique, the cycle (i.e. structured interrogation, controlled feedback and anonymity of participant responses), it can demand a great deal of time, especially when done on a regional or worldwide basis. What is called for is the development of a methodology that has the expanded, synergistic power of this multi-method approach, but is much less costly in time and resources.

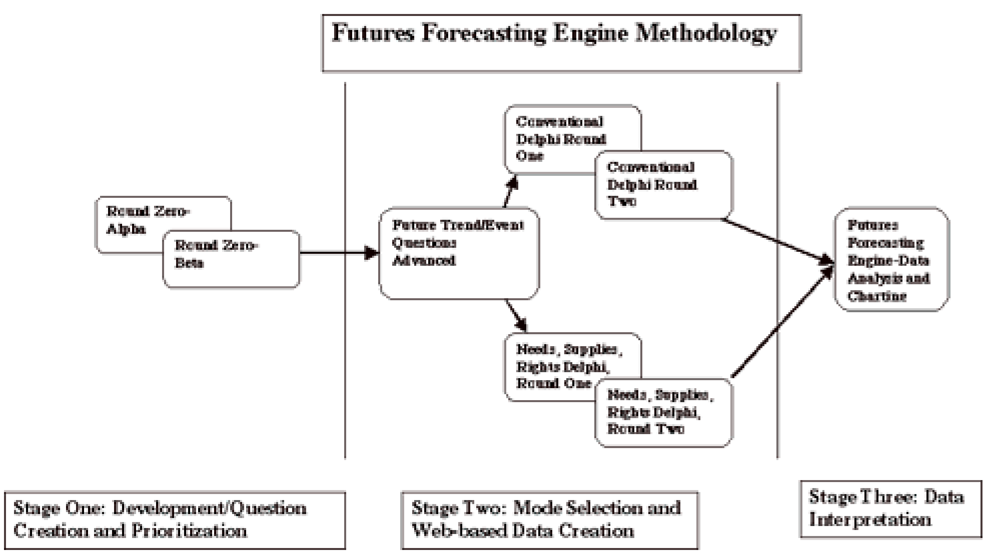
An Online Methodology for Forecasting

As noted above, a methodology is a research approach that often involves multiple techniques. In futures research, where there is often little or no reliable data about the future, methodologies often *create* data rather than merely collect it. In a global information age such a methodology would involve electronic networking, i.e. the World Wide Web (WWW) and would be scalable from a local to a global level. In earlier work (Wedemeyer, Ono & Winter, 2001), it was set out that "expanding timeframes of ‘anticipatory' research requires the invention of new or expansion of existing methodologies/methods. Most certainly the advancing ‘world brain' made possible by the Internet, promises new capabilities. Substantial multi-method research and development in ‘networked forecasting' needs pursuing."

As mentioned, harnessing multi-layered, complex, slowly emerging problems benefits from unconventional methods of research. Often times the sources for data creation are dispersed and limited in number. The high levels of expertise required make such undertakings expensive. Given these requirements and conditions, it is important to develop methodologies that are both powerful and efficient. Work on and refinements of this methodology has been underway for more than two decades (e.g. Wedemeyer, 1978; Wedemeyer, 1987; Wedemeyer and Ono, 1994; Wedemeyer, 1998).

The process should be able to handle both quantitative and qualitative data and be capable of processing or adding value to that data. Such is the case in the forthcoming description of a three-stage Futures Forecasting Engine (FFE) methodology. The proposed methodology does not purport exactness; rather *it systematically tries to reduce uncertainty while creating data about the future*. The process has three stages: a Zero Round Alpha and Beta; a two-round online Delphi; and, a processing and an interpretation stage. Each of these stages will be pursued in detail below.

Three stage Futures Forecasting Engine (FFE) Methodology



The *Futures Forecasting Engine* (FFE) Methodology: System Overview

This Futures Forecasting Engine (FFE) methodology is designed to take advantage of the Internet and its WWW capabilities. Custom software has been developed for this purpose and is referred to as an FFE application. This is an electronic system, accessible via any World Wide Web browser connected to the Internet.

The administrator/ researcher is greatly assisted by the automated features of the FFE. During study setup, the administrator establishes the time-span of the study. The specific experts are located and their electronic mail addresses are established. The study begins by sending each expert a formal letter of request to participate. A letter of endorsement from a relevant entity is included, and an access URL (web address) is provided.

When the expert accesses the secure URL he or she is asked to initiate input by entering his or her e-mail address. All data collection is administered via the Internet and all responses are encrypted and kept in the strictest of confidence. In addition, while comments are captured, they are not attributed to any participant in any phase of the methodology. The e-mail address is used solely for administrative purposes (i.e., the number of responses and each expert's personal response is used by the administrator and FFE for control and feedback purposes).

Stage One: Zero Round "ALPHA" Sub-phase

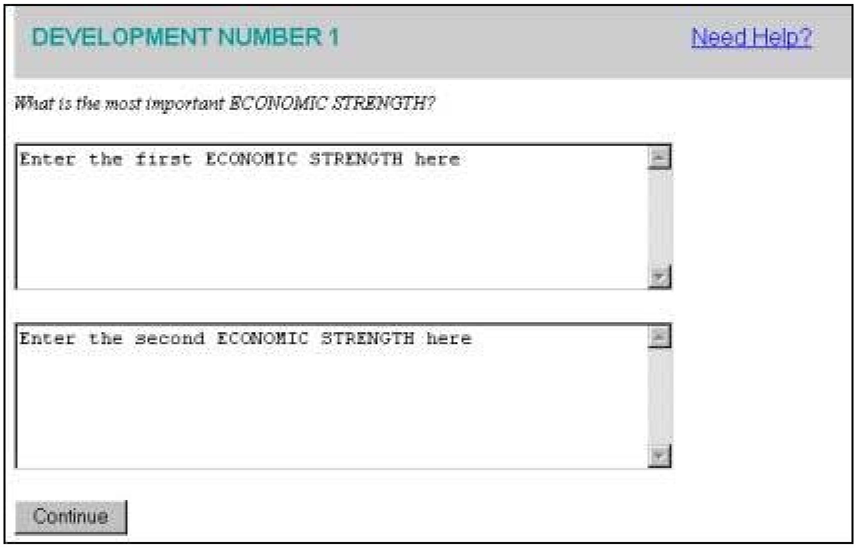
Stage One focuses on idea and question generation. It is intended that the Zero Round Alpha sub-phase facilitate key development suggestions from each of the selected participants. To accomplish this, each will be asked to provide a qualitative response to questions in up to sixteen (16) categories. These categories are derived by a four by four (4X4) matrix of Economic, Social, Political and Technical (ESPT) developments as they correspond to Strengths, Weaknesses, Opportunities and Threats (SWOT) related to the research focus. SWOT analysis is a technique that seeks to identify both internal factors (strengths and weaknesses) and external factors imposed by the environment (opportunities and threats) faced by an organization (or other entity, e.g. region) in order to guide strategic planning.

Strengths (of)	Weaknesses (of)	Opportunities (for)	Threats (to)
Economic	Economic	Economic	Economic
Social	Social	Social	Social
Political	Political	Political	Political
Technical	Technical	Technical	Technical

SWOT/ESPT Developments Matrix

During setup, the administrator is able to select all or portions of the matrix for inclusion (e.g. just Economic and Technical developments or just Weaknesses and Threats).

The participants will be asked to provide what their thinking is regarding the key developments in each of the cells of the matrix. They will see one question at a time and will have the opportunity to contribute up to two comments for each.



Example of Developments input screen

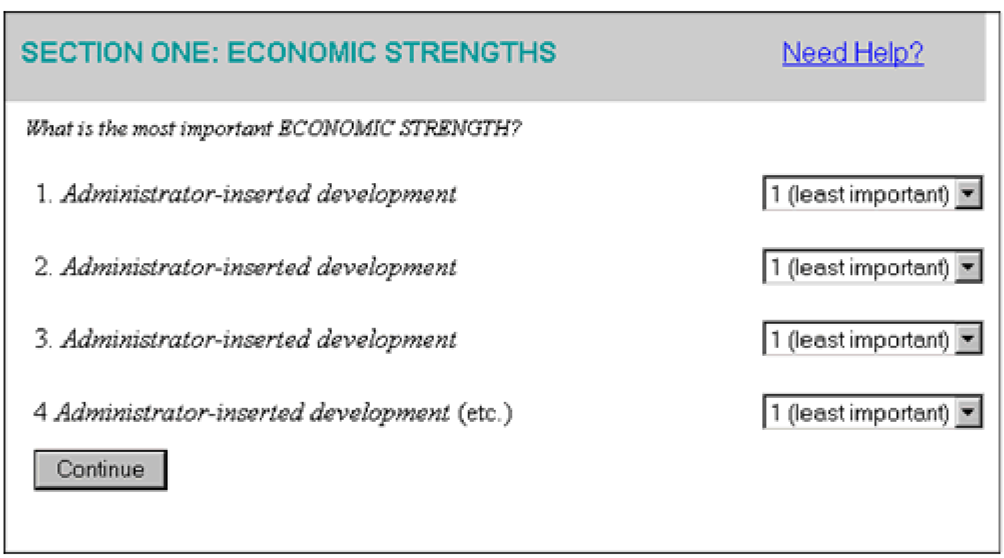
After each selected cell question is completed, the participant will be asked to electronically submit his/her input. When completed, the FFE will then sort/compile all qualitative statements/responses by cells for the administrator to prepare the Zero Round Beta questionnaire. This requires that the administrator remove duplicate developments and balance a tolerable number of developments across the matrix.

Stage One: Zero Round "BETA" Sub-phase

The purpose of the Zero Round Beta sub-phase is to prioritize the suggested key developments set out by the selected experts in the Alpha sub-phase. At this time, the same group of participants would receive an e-mail message asking them to return for the Zero Round Beta. The participants would rate the "importance" of each of the items brought forward from the Alpha Round (1 being least important, 7 being of highest importance).

In the Beta sub-phase there are up to sixteen sections, paralleling the cells described above. Each section contains multiple questions.

A sample section and questions would appear as follows:



Example of Developments prioritization screen

Upon completion the participants electronically submit their assessments to the administrator and the program computes and ranks the developments for each cell. The Zero Round contributes:

- The generation of developments which may be central to the described problem; and,
- The rank ordering of these developments that will facilitate Delphi trend and event question generation.

This sets the conditions for the subsequent generation of trend and event questions for Round One of the online Delphi forecasting study.

Stage Two: Delphi Futures Forecasting Engine (FFE)

The next stage of the FFE methodology employs a two-round Delphi. Two distinct modes have been developed: 1) a modified, conventional Delphi; and, 2) a Needs, Supply, Rights (NSR) Delphi. The forecasting engines are generic, capable of handling any selected topic(s). These forecasting engines allow:

- Round One Delphi trend levels and event probabilities estimates (described below);
- Self-assessment of expertise levels (low level expertise estimates can be discarded from the forecast pool);
- A calculation of the composite certainty of each forecast;
- Round Two feedback to each expert (group range of estimates, the median for each development and their personal Round One estimates);
- Solicitation of comments (qualitative data) from each expert on each trend and event question;

An assessment of the impact (positive or negative) of the event *if* it were to occur; and,

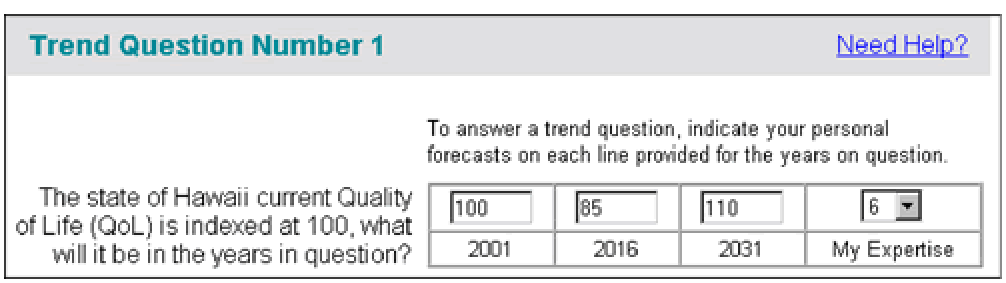
Sophisticated analysis of final forecasts, including rate of change, charts of trends and event, uncertainty indicators for each development, and in the Needs, Supply and Rights Mode, action urgency indices (AUI).

Examples of Trend and Event Developments in the Conventional Mode Futures Forecasting Engine (FFE)

Future developments can be broken into two types: *trends* and *events*. Trends are gradual indicators over time (e.g. quality of life). Events behave quite differently; they occur abruptly (e.g. the passage of a law or a medical breakthrough). In futures research it is often assumed that events drive trends and/or other events; to a lesser degree trends may influence, but not necessarily drive, other trends. In the "conventional mode", the Futures Forecasting Engine (FFE) behaves as follows:

Trends: Trends may or may not change over time. Trends have differing units of analysis. Some may be indexed to a particular level in the present and the forecast participants are asked to estimate the level in specified years in the future. The conventional FFE would present the question as follows:

Trend Question Example:

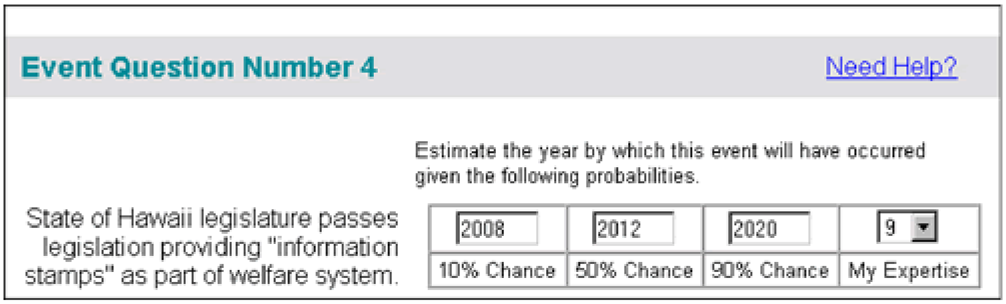


Example of trend question screen in Conventional mode

The respondents may choose to reduce the level by 15% in 15 years resulting in 85. Fifteen years later they may believe it to increase from a level of 85 to a level of 110. On the other hand, a participant may see no change whatsoever over the entire 30 year period. In the above example the respondent rated his/her expertise level at six (6) on a range of 0-10.

Events: Events are tied to probabilities over time. A specific event is clearly stated as a declaration (usually with a working definition or qualification). The forecasting participants are asked *by which year the event will have occurred* with differing probabilities. For example, a slight chance (.1 or 10%), a moderate chance (.5 or 50%) and a high chance (.9 or 90%) that the event will have occurred. The FFE presents the statement and requests a response as follows:

Event Question Example:



Example of event question screen in Conventional mode

Here the participant would be asked by which year there would be a 10% chance that this event would have happened (e.g. 2008); when there is a 50% chance that it will have occurred (e.g. 2012) and a 90% chance by which it will have occurred (e.g. 2020). If the respondent believes the event never has a chance of occurrence, he or she could respond with "never" for any or all probabilities. This is the rationale that the median is employed in the calculations instead of the mean. In the above example, the respondent rated his/her expertise level at nine (9) on a range of 0-10.

Round One and Round Two: Conventional Mode Delphi via the Internet

All event and trend questions go through two rounds of estimates. Round One consists of number of trend and event questions and asks each respondent to estimate his/her personal level of expertise for each (1-10, 10 being the highest). The FFE can be set to disregard all estimates by those respondents rating him or herself at 3 or below. It is assumed that not all participants will be experts on all areas. This promotes the inclusion of only the estimates of self-assessed high expertise.

The administrator determines when Round One has reached an acceptable number of expert responses. This varies by application, but a rule of thumb is the first round responses should fall into a range from 30-60, and the second round within a range from 15-30 advanced experts, (Personal Communications, Helmer, 1975). The administrator then has the engine calculate the necessary statistics (described below) and switches the engine to a Round Two phase. The administrator then notifies each expert via e-mail when it is time to enter the second round estimates.

When the second round is initiated, the FFE calculates the range of each trend level/year and each event probability/year. These calculations provide the median and the semi-interquartile range (the middle 50% of all participants' estimates). In addition, each expert receives his or her First Round estimates as a reminder. The expert is then asked to provide a Round Two estimate. If the Round Two response is outside the semi-interquartile range, the FFE prompts the respondent to provide a comment to justify the estimate. In this way, the engine is capable of collecting qualitative as well as quantitative information. The FFE holds the comments in question-sorted cells for later use in analysis. The comments are ranked by calculating expertise by certainty.

Once the administrator is satisfied that the number of responses is sufficient to complete the Second Round, the FFE is directed to perform a number of calculations. The earliest occurring events are rank ordered from earliest to latest occurring (e.g. by what year there is a 10%, 50%, and 90% chance that the event will have occurred).

A second assessment is performed from the impact of the event *if* the event occurs (positive or negative). These are obtained directly (Very Positive +7 ... 0 ... -7 Very Negative) from the estimates from the participants. This provides a rank ordering of the most important to the least important events (positive and negative) if they do occur.

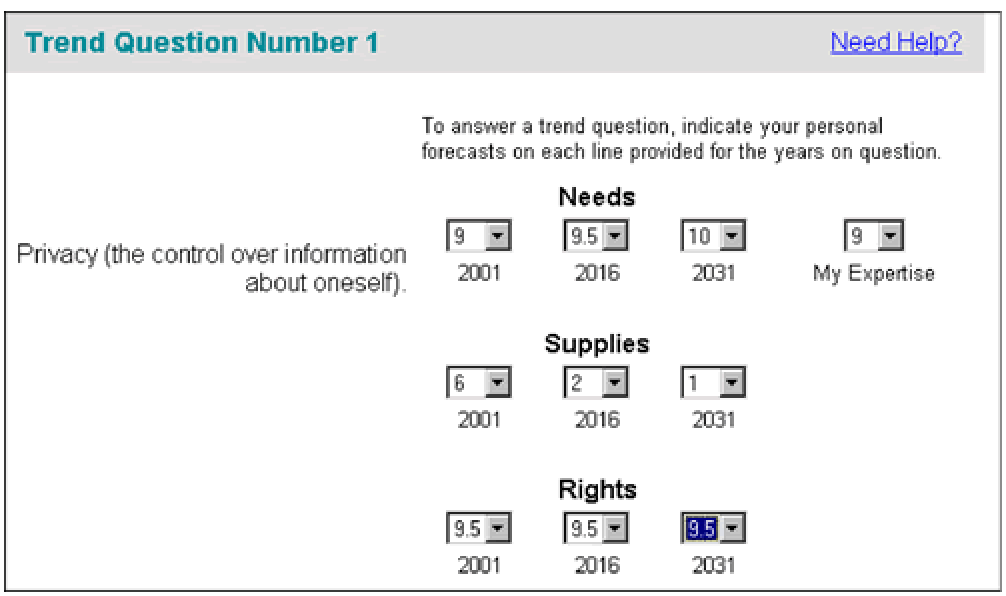
A third set of calculations is also performed. This time the FFE determines which trend displays the most change (positive or negative) and rank orders them by years (e.g.15 years into the future, 30 years into the future). This is regarded as a *dynamics index* and is displayed in table form.

In addition, the FFE depicts the spread of the semi-interquartiles. This provides an indication of *uncertainty* for each development. For example, a very large semi-interquartile range would indicate higher uncertainty than a narrow spread. An additional uncertainty measurement is derived from the second round solicitation and self-assessments requested of each participant. A 1-7 uncertainty scale, seven indicating the highest expert certainty, is used to calculate the average certainty for each trend and each event.

This information along with charted data is provided to the analysts for interpretation, scenario generation or regeneration and alternative actions.

Need/Supply/Rights (NSR) Mode of the Futures Forecasting Engine (FFE)

The administrator may also select an alternative mode of forecasting at the time of setup. This mode was first developed and administered in a traditional (i.e. via paper/postal means) by the author (Wedemeyer, 1978). Its validity was probed and found to be relatively high fifteen years after the study (Wedemeyer and Ono, 1994). The choice of mode is dictated by the problems at hand. While the events data generation capabilities remain the same as set out in the conventional mode, the trend data is quite different. In the NSR mode, each trend is broken out into three dimensions: Needs (for) Supplies (of), and Rights (to) a particular development. In other words, the need for a particular development, the available supply of something, and the right (i.e. the cultural and/or human) to have something.



Example of trend question screen in NSR mode

Each of these dimensions is broken into three time frames (any span of years can be assigned by the administrator). The respondent is asked to set the trend level for Needs/Supplies/Rights for each of the three years using a pull-down menu (from 10 to 1, ten being highest). In the NSR mode the estimated units are not a real "unit" quantity of the trend; rather, each participant is asked to set "benchmark" levels (10 to 1) and to estimate how these may vary over the years and how they may differ between Needs and Supplies. If the respondent sees the Needs and Supplies in balance, the responding levels would parallel each other. The Rights levels for each year in question could remain stable or change positively or negatively over the years in question.

The same procedures as described above are followed for Round One and Round Two. At the end of Round Two, the FFE performs a number of calculations and produces several charts and tables. For example, a chart for each trend is created that plots the changes in Needs, the changes in Supplies and the changes in Rights. In addition, the overall (initial year to end year) changes for each of the Needs, Supplies and Rights are calculated, ranked from highest to lowest, and displayed in a "dynamics" table. The engine also calculates the difference between the Needs and Supplies values and ranks this difference from highest to lowest in table form. Finally, the difference between the Needs and Supplies level for each trend development is calculated and the result is multiplied by the Rights level. The resulting quantities are rank-ordered from highest to lowest in several Action Urgency Index (AUI) tables discussed later in this paper.

These results are most powerful in assisting a policy analyst. For example, a large difference between the Needs and Supplies multiplied by a small Rights quantity results in a small number and, most probably, a low ranking development requiring action. Compare this to a relatively small difference between a Needs level and a Supplies level multiplied by a large Rights quantity. This would result in a higher number and consequently a high-ranking trend, indicating a need for more immediate attention. This indicator, referred to as an *Action Urgency Index* (AUI), is calculated for each trend and subsequently ranked from highest to lowest quantities. High-ranking trends suggest imbalances, high dynamics and priorities for action.

While this information is of high value in table form (showing the highest to lowest needs for actions), it is perhaps of greatest value in chart form. After the FFE calculates each Needs/Supplies multiplied by Rights level, a value is derived for each year. Plotted in chart form, each trend indicates when it would tend to become a problem and the severity of the problem (steepness of the curve). Once depicted and analyzed, it would indicate the timeframe and urgency for action. If ignored, such indicators could have costly consequences.

Use and Utility of the Futures Forecasting Engine

The FFE is a generic research tool that can facilitate forecasts in a broad range of topics for a wide range of subsequent applications. The resulting data will be very useful in formulating government policies or better-founded strategic plans within single organizations. It is scalable, and can be utilized by and valuable to both public and private entities. Because it employs online data collection via the Internet, it is very time-efficient with powerful data processing capabilities. This makes it possible for it to be utilized to probe opinions (create data) for short-range or long-range decision making on a local, regional or global basis.

Conclusion

Uncertainty increases the demand for information. The more promising the accuracy of the information the more value it possesses. When high certainty is impossible (e.g. futures research), systematic and sophisticated inquiry seeks to reduce as much uncertainty as possible. Although potential lack of validity (accuracy) is implicit in futures research, such a condition does not dismiss the need to strive for validity and reliability. It is for these reasons that anticipating alternative futures or slowly emerging longer-range problems requires sophisticated and systematically developed and tested approaches.

The necessary approaches and methods are embedded in the inexact sciences. Precise problem definitions are often impossible, yet advancing descriptions of the problem(s) assists in the selection and the development of appropriate methods or techniques and in asking the appropriate questions. Substantial multi-method research and development in 'networked forecasting' has substantial promise and is worth pursuing. This is the rationale of this paper, where an online, web-based, futures forecasting methodology has been advanced.

Specifically, a three-stage approach has been offered: Stage 1) Zero Round with Alpha and Beta sub-phases;

Stage 2) two Delphi forecasting engines with conventional and NSR modes; and, Stage 3) analysis and various data representation capabilities. The Futures Forecasting Engine methodology is generic with an open architecture where any or all three stages can be used to investigate/forecast/address any describable problem(s). In addition, the engine is organizationally nonspecific and scalable. It can be deployed in the public or private sectors and on local or global scales.

In summary, after years of development an Internet-based futures forecasting engine is now available. It is a tool that promises to contribute significantly to medium and long-range strategic planning and policy formulation.

Biography

Dan J. Wedemeyer is a Visiting Fellow at the East-West Center in Honolulu, Hawaii and Professor of Communication at the University of Hawaii, Manoa, USA. He holds a BA Degree from Iowa State University, an MA Degree from the University of Hawaii, Manoa, an MA Degree from the University of Southern California and a Ph.D. from the University of Southern California, Annenberg School of Communication.

Dr. Wedemeyer's research has focused on forecasting and on telecommunication policy, planning and human resource development. He is Director of the Graduate Certificate in Telecommunication and Information Resource Management (TIRM), President and CEO of Communication Associates, Inc. and serves on the Board of Trustees of the Pacific Telecommunications Council.

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