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Scenario Analysis: An Integrative Study and Guide to Implementation in the United States Air Force

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THESIS

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SCENARIO ANALYSIS: AN INTEGRATIVE STUDY AND GUIDE TO IMPLEMENTATION IN THE UNITED STATES AIR FORCE

THESIS

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Air Education and Training Command
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Master of Science in Logistics Management

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Abstract

With the uncertainties in the current Air Force environment, extrapolated forecasting methods are no longer sufficient for meeting the Air Force's strategic planning needs. The Air Force could benefit from using a more sophisticated method to determine the opportunities and obstacles it will face in the future. The key characteristics that distinguish scenario analysis from other forms of forecasting are the qualitative, contextual descriptions of the future environment, and the identification of several possible futures. This thesis discusses the concept of scenario analysis and its relevance to the Air Force as a strategic planning tool. It begins with an overview of strategic planning and forecasting concepts. The current literature on scenario analysis is then integrated into a single reference discussing general concepts, construction methodologies, and corporate applications. The various approaches to scenario analysis are compared and incorporated into a composite model. Appropriate applications of scenario analysis within the Air Force are discussed, and a step-by-step guide is presented to assist Air Force managers and planners in implementing scenario analysis.

SCENARIO ANALYSIS: AN INTEGRATIVE STUDY AND GUIDE TO IMPLEMENTATION IN THE UNITED STATES AIR FORCE

I. Introduction

Scenario analysis has emerged in the past two decades as an improved method for organizations to deal with the uncertainties of the future. Developed in response to the failures and limitations of the strictly quantitative methods of forecasting, the scenario analysis method can integrate nonquantifiable data to develop a more qualitative, contextual approach to describe the future. Rather than producing a single extrapolated forecast, the scenario development method can generate multiple scenarios of plausible futures that can increase the robustness of an organization's strategic plans.

The scenario analysis method has been used in large, multinational companies such as Shell Oil, Pratt & Whitney Aircraft, Exxon, and General Motors (Enzer, 1981:469); but it can also be applied in small businesses such as restaurants and home building (Foster, 1993:123). Linneman and Klein (1983:95) surveyed Fortune 1000 companies and found that half of them claimed to use scenario analysis. Surveys by Malaska, et al. (1984) revealed that the percentage of large European companies that use scenario analysis rose from 36 percent in 1984 to 40 percent in 1985 (Bunn and Salo, 1993:291).

Instead of basing plans on a single, quantitative forecast, multiple scenarios are used to cover a broad spectrum of possible environments an organization could face in the future. Brauers and Weber (1988:32) define a scenario as "a description of a possible future state of an organization's environment considering possible developments of

relevant interdependent factors in the environment." Becker (1989:61) views scenarios as "plausible descriptions of future conditions with which the organization could be faced." A scenario can also be described as "a route through a decision tree, supported by a narrative catalogue of the events and opportunities" (Bunn and Salo, 1993:292).

Foster (1993:123) likens the scenario method to the case study method used in graduate level business courses. The case study method uses descriptions of business situations in the past as learning tools for students to practice management strategies. Similarly, scenarios are descriptive narratives about possible future environments that an organization could encounter, and can be used by managers to test the resilience of their strategic plans in each of the possible futures.

Scenario analysis evolved as an improvement to traditional forecasting methods, which were unable to alert managers to unexpected events that would occur in the future.

> The 1950s and 1960s were marked by a growing belief that the future could be made more certain through increasingly sophisticated systems of analysis, data gathering and processing, leading to greater control. The events of the 1970s have undermined this belief, and thus the future appears to be comparatively more uncertain against this former certainty that the future could be predicted and controlled.... Meanwhile, the increasing complexity of our socio-economic systems has increased the need for effective planning. But the increasing complexity of these systems has made planning more difficult. That is the dilemma facing modern planners. (Beck, 1982:13)

Planners came to rely on the advanced mathematical methods of analysis which required the inputting of large volumes of data into computers. The resulting outputs were considered to be objective, scientific solutions, without much thought given to the accuracy of the data originally input into the system.

> These developments were starkly exposed when the 1970s arrived with various economic crises that exposed the nonsense of many previous forecasts and demanded a fundamental reappraisal of existing planning systems. In the course of this reappraisal, the whole basis of modern

> planning -- with its use and production of forecasts -- became increasingly suspect. (Beck, 1982:13)

Several weaknesses of the traditional forecasting methods are exposed by the following examples. Before 1973, it was widely predicted that oil prices would never go above $2 per barrel, and inflation was predicted to disappear. However, the 1981 price of oil averaged $31 a barrel (US Bureau of the Census, 1993:495). In the 1950s and 60s, nuclear power was seen to be a major energy source for the future, whereas by the 1980s, nuclear power was contributing only a minor 3 percent portion of energy production outside communist areas (Beck, 1982:14).

The growing complexity of society is making extrapolated trend forecasts less reliable. Unless the planning horizon is near and the business setting is simple, "single point" forecasts do not realistically portray the future. Rather than showing a range of possible outcomes, they focus on identifying only the most likely future. However, a single point forecast is based on a set of assumptions which are uncertain. If the assumptions are not valid, the resultant single-point forecast can be highly inaccurate. Becker (1989:62) explains that a scenario should not be viewed as portraying a certain future, but rather as describing a set of possible future conditions. The multiple scenario approach has a wider focus which systematically considers the spectrum of uncertainties in the environment (Boroush, 1992:25).

The evolution of environmental factors such as the globalization of national economies and the growth of robotics and computer technologies illustrates the need for scenario analysis to be incorporated into organizational planning strategies. Organizations are using more distant planning horizons, and are emphasizing environmental assessment strategies that monitor and forecast trends occurring in the organization's environment. Multiple scenarios are being used to a greater extent, and more emphasis is being placed on adaptive strategies which will be resilient in the face of future uncertainties (Linneman

and Klein, 1985:73-74). "Scenario analysis seems best suited for those situations where a few crucial factors can be identified, but not easily predicted" (Schnaars, 1987:108).

The scenario analysis approach involves scanning the environment for the kinds of "discontinuities" that could transform dominant industry/market patterns, such as technological breakthroughs or the rapid erosion of a long-standing market entry barrier. The goal is to understand the mix of decisions and planning targets capable of creating competitive advantage in the face of various uncertainties and challenges posed by the external environment (Boroush, 1992:25).

The implementation of scenario analysis can provide many benefits to an organization. Scenario analysis can be used as a learning tool for managers to appreciate the uncertainties of the future. Strategic plans can be adapted to be more flexible for a number of future environments, and contingency plans can be drawn up. Developing a range of scenarios for choosing business decisions minimizes risk and enables programs to be readjusted as conditions change (Becker, 1989:61-62). "Scenario building, hand in hand with a careful analysis of the driving forces, fosters systematic study of a number of possible outcomes. This forecasting approach enables decision makers and planners to grasp the long-term requirements for sustained advantage in their business" (Boroush, 1992:25).

Implementation in the United States Air Force

Scenario analysis can be implemented in many types of organizations, at different levels within those organizations, and for several different purposes. Any organization that needs a method for planning for the uncertainties of the future could benefit from the use of scenario analysis.

The United States Air Force employs strategic planners at the Air Staff and major command levels for a variety of purposes, ranging from developing contingency wartime

plans to allocating resources to acquiring new weapon systems. A greater emphasis is being placed on planning for the future at the wing level, and even the squadron level, in part because of the move toward the Total Quality Management philosophy. Strategic planning will become even more important as the Government Performance and Review Act of 1993 is implemented in the armed services. This act will require that all governmental agencies plan, budget, and review performance based on outcome-oriented objectives (Senate Report, 1993).

The environment that the United States Air Force will face in the future is marked by uncertainties in US-international relations, economics, politics, and even public sentiment. Traditional mathematical models that can only manipulate quantifiable data will be insufficient to help Air Force planners and leaders see into the future.

Scenario analysis has helped several multinational companies to hedge risks, implement robust strategies, and monitor the progression of events in the environment and their implications for the organization. The United States Air Force can similarly benefit from this approach.

The Purpose of This Thesis

The purpose of this thesis is to integrate the many writings on scenario analysis into a single source by contrasting the divergent definitions and views and by comparing the methodologies employed by different organizations. The different approaches to scenario analysis will be synthesized into a useful composite model. Recommendations on introducing scenario analysis to an organization, and a step-by-step plan for implementation at different levels of the United States Air Force will be presented.

Investigative Questions

This research effort will answer the following four investigative questions:

1. Where does the relatively new method of scenario analysis fit into the general scheme of strategic planning?

2. What approaches to scenario analysis exist, and what are their characteristics?

3. What commonalties exist between the different approaches to scenario analysis? How can they be synthesized into an overarching, useful model?

4. What guidelines could facilitate the US Air Force's implementation of scenario analysis?

Overview of Thesis

Chapter II of this thesis describes the method of descriptive research used to obtain information from secondary data sources. The descriptive research methodology is defined, and the steps used in collecting the data are presented. The advantages and disadvantages of using secondary data sources are also discussed.

Chapter III presents an integrative review of the current literature on scenario analysis. The framework of strategic management is discussed first, followed by the subprocess, environmental analysis. Forecasting is then addressed as an introduction to the literature on scenario analysis. Several aspects of scenario analysis are discussed, including definitions, uses, classifications, construction methodologies, and corporate applications.

Chapter IV presents a synthesis of the material found in the literature review. Various models of scenario development are compared, and a composite model is presented. Applications in the United States Air Force are discussed, as well as advantages and disadvantages of using scenario analysis. General guidelines are also presented, and recommendations for future research are given.

The final product of the thesis is presented in Appendix B: a guide for effective implementation of scenario analysis in the Air Force. Diagrams, step-by-step methods, and instructions are given to help an Air Force organization determine the most suitable kind of scenario analysis method to use. Recommendations on gaining acceptance for the method and for effective implementation are also provided.

II. Methodology

Descriptive Research

The methodology used for this thesis is the descriptive research method, utilizing secondary sources to provide descriptive representations and analyses of a topic. The difficulty of a descriptive study can range from simple to complex, but the amount of research that is involved and the standards upon which the study is based should be just as rigorous as the more idealized causal study (Emory and Cooper, 1991:148).

Descriptive research describes events by gathering information from various sources; however, it does not necessarily test hypotheses, make predictions or explain causal relationships. Although research authorities do not agree on a particular definition of descriptive research, they do state that it may involve all forms of research except historical and experimental research (Isaac and Michael, 1990:46).

Descriptive research involves combining, in a logical manner, the evidence obtained from previous research and documents. The objective of descriptive research is to describe the facts and characteristics of an area of interest systematically and accurately. From other records and studies we can make generalizations which may guide us in our future actions and decisions (Hillway, 1956:141). Van Dalen (1979:345-346) states other purposes for using descriptive research methods:

1. To collect detailed factual information that describes existing phenomena.
2. To identify problems or justify current conditions and practices.
3. To make comparisons and evaluations.
4. To determine what others are doing with similar problems or situations and benefit from their experience in making future plans and decisions.

The third and fourth purposes listed above are emphasized in this thesis.

Secondary Data Sources

The information contained in this study is from secondary data sources. To acquire secondary data, the researcher accumulates and analyzes information that was obtained by others. The major advantage of using secondary sources is that the data can be found quickly and inexpensively. For most research on past events, secondary sources are the key source of information.

There are two main disadvantages to using secondary sources: the information may be out of date, and the information may not meet the specific needs of the researcher. The original information was collected for specific purposes, and may be in a format or based on certain assumptions that are not conducive to the secondary research method (Emory and Cooper, 1991:288).

The data for this thesis was collected from various external sources such as computerized data-base retrieval systems, bibliographies and expert opinions. References were found by using a reference database called the ABI/INFORM (Abstracted Business Information) computer information retrieval system, developed by U.M.I/Data Courier, Louisville, Kentucky. The database contains abstracts and bibliographic references for articles from over 400 journals and periodicals (Emory and Cooper, 1991:294).

Additional references were located from the bibliographies of these articles and from readings for a graduate level course in strategic planning. Furthermore, information was retrieved from books recommended by expert sources such as university instructors and thesis advisors.

Steps to Obtain Data

The following steps were adapted from Isaac and Michael (1990:46) and provide the general methods used in obtaining the data from the sources listed above.

1. Define the objectives in specific and distinct terms by stating the facts and attributes that are to be researched. A primary objective of this thesis is to collect and integrate literature on scenario analysis. Another key objective is to compile a handbook for practical implementation of scenario analysis in the United States Air Force. These objectives dictate a broad literature search for any writings that pertain to the scenario analysis method, including research-oriented findings, descriptive methodologies, practical applications in organizations, and tips on implementation.

2. Design the approach by defining how the data will be gathered, what references will be excluded, and the time frame from which the data is to be collected. For this thesis, the data will be gathered in the process of a comprehensive literature review, utilizing computerized reference databases, recommended sources, and cross references. An emphasis will be placed on more current literature, dating from 1980 on, although previously published material will also be used to form the historical basis of the development of scenario analysis.

3. Collect the data. This step involves the actual procedure of collecting the data from the sources listed and the reporting of the data in an integrative format in chapter III, literature review.

4. Report the results. The researcher interprets the results by comparing and contrasting the findings of the different studies. Chapter IV of this thesis will consist of comparisons of different approaches to scenario analysis. Tables contrasting the steps of different scenario analysis methodologies will be introduced, as well as an overall model encompassing the various methods. Finally, a guide to implementation in the United States Air Force and practical hints will be presented in Appendix B.

Investigative Questions

This research effort will answer four investigative questions and their related measurement questions:

1. Where does the relatively new method of scenario analysis fit into the general scheme of strategic planning?
    - Is scenario analysis a forecasting method?
    - How widely is scenario analysis used?
    - How does scenario analysis perform in comparison with traditional quantitative methods?

2. What approaches to scenario analysis exist, and what are their characteristics?

3. How can the different approaches to scenario analysis be synthesized into an overarching, useful model?
    - What common elements exist between the different approaches to scenario analysis?
    - Is there a logical order for the steps of scenario analysis?

4. What guidelines could facilitate the US Air Force's implementation of scenario analysis?
    - Are there general guidelines that could be applied in any organizational setting?
    - Can scenario analysis be applied at different organizational levels within the Air Force?
    - What decisions need to be made in structuring a scenario analysis?

Investigative questions one and two will be answered in the literature review in chapter III. Investigative question three will be answered in chapter IV, and question four will be addressed in chapter IV and Appendix B, Scenario Analysis Implementation Guide for the US Air Force.

III. Integrated Literature Review on Scenario Analysis

Overview

Although its origin dates back to the 1950s, scenario analysis is still a rather new, growing field of study. Several major corporations use scenario analysis for strategic planning, and more articles are appearing in business journals about this unique method. However, much research is still needed in this field of study to fully test the benefits of scenario analysis. The purpose of this chapter is to integrate the current literature about scenario analysis into a single source, to be used as a reference for instructional purposes and as a springboard for future research.

This chapter begins with a discussion of strategic planning and proceeds through levels of increasing detail before arriving to the discussion on scenario analysis. The general areas are discussed first to provide background: strategic planning, environmental analysis, and forecasting. Next, several aspects of scenario analysis are covered, including definitions, uses, classifications, construction methodologies and corporate applications.

Strategic Planning

Mintzberg (1987:27) highlights the important role of strategy in an organization: "organizations need strategy to set directions for themselves and to outsmart competitors, or at least enable themselves to maneuver through threatening environments." According to Mintzberg, strategy plays many roles in an organization. It focuses and coordinates the efforts of the different departments and people within an organization. Strategy defines an

organization by laying out a position on the mission of the group. It also provides consistency in an organization by reducing uncertainty, establishing order and direction, and promoting efficiency.

Drucker (1959:240) expounds the need for strategy and the organized, systematic process of long-range planning. This need for long-term planning is precipitated by four realities. First, the time span in which managerial decisions are made has lengthened to such an extent that the uncertainty of future conditions and the risks associated with a given decision must be carefully considered. Second, we are in an age of "violent technological flux, rapid obsolescence, and great uncertainty." Third, organizations, and even society and the economy in general, have become more complex. An integrated plan is needed to coordinate the activities of specialized departments within an organization. Lastly, the workers of an organization make entrepreneurial decisions constantly, and need a grasp of the overall mission and goals of the organization as a framework for decision-making.

Although long-range planning does not deal with future decisions, "it deals with the futurity of present decisions" (Drucker, 1959:242). Strategic planning cannot eliminate the risk associated with future events, but it is a tool for knowing and understanding the risks being taken.

Hax and Majluf (1991:2-3) describe the concept of strategy by the following dimensions:

1. Strategy is a coherent, unifying, and integrative pattern of decisions.
2. Strategy determines and reveals the organizational purpose in terms of long-range objectives, action programs, and resource allocation priorities.

3. Strategy attempts to achieve a long-term organizational viability, by responding properly to the opportunities and threats in the...environment, and the strengths and weaknesses of the organization.

A major component of strategic planning is the study of the environment in which an organization operates. This process is termed "environmental analysis," and is a method used to collect and analyze data for the purpose of forecasting trends in the future. This analysis provides information essential to the decision-making process and to the defining of strategies, tactics, and objectives.

Environmental Analysis

Environmental analysis is an essential subprocess within the overall process of strategic planning. However, before environmental analysis can be discussed, the term "organizational environment" must first be defined. An organizational environment is comprised of "the factors external to an organization that influence its functioning and performance" (Narayanan and Nath, 1993:196). Examples of these factors include the actions of competitors, economic conditions, political influences, the state of technology, and governmental influences. The factors that are linked to the performance of the organization are the ones brought into focus in the process of environmental analysis. Narayanan further states that under systems theory, the concept of an external environment that impacts an organization is based on the perspective of the organization as an open system. The outputs of environmental analysis form the framework of strategic decisions, which provide direction for the management of an organization and its

subsystems, as shown in Figure 3-1. Therefore, environmental analysis is the first link in the chain of devising and implementing strategy for an organization.

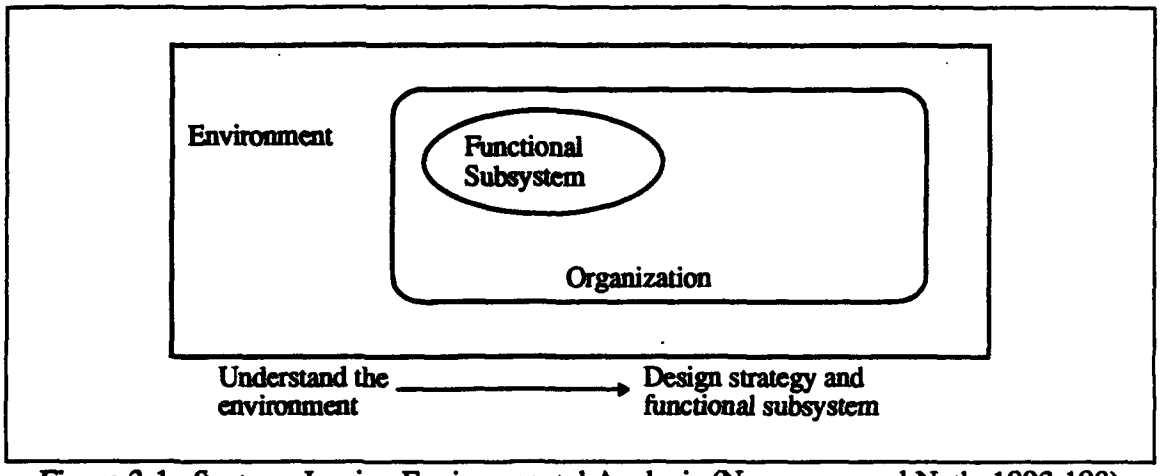

Figure 3-1. Systems Logic: Environmental Analysis (Narayanan and Nath, 1993:198)

Environmental analysis is the process that decision makers in an organization use to examine the environment in which the organization operates. The benefits of environmental analysis are:

1. It increases managerial awareness of environmental changes taking place.
2. It strengthens the strategic planning process by expanding an organization's understanding of multinational settings, improves diversification and resource allocation decisions and simplifies risk management.
3. It centers management's attention on the influences of strategic change.
4. It provides management with the ability to capitalize on opportunities and respond to changes within the environment. (Ginter and Duncan, 1990:92-93)

Environmental analysis contributes valuable information to an organization by describing many facets of organizational changes taking place. It provides a forewarning of external issues that need to be addressed, aiding in the identification and understanding of such trends and allowing time for planning and adaptation. Environmental analysis is

not a crystal ball used to predict the future. It does, however, identify elements of the environment that can be predicted with some certainty, and provides potential outcomes for more ambiguous areas. The same distinction is applied to the field of strategic planning as a whole (Narayanan and Nath, 1993:197).

> The question is not what will happen in the future. It is: what futurity do we have to factor into our present thinking and doing, what time spans do we have to consider, and how do we converge them to a simultaneous decision in the present? (Drucker, 1959:239)

Classifications of Environments. The first task of environmental analysis is to define and describe the organizational environment on three levels: the task environment, the industry or competitive environment, and the macro environment. The first, the task environment, includes all parties directly related to the firm, such as customers, competitors, suppliers, and trade agencies. This environment is specific to a firm and involves many of the firm's day-to-day operations.

The industry or competitive environment includes the factors that all firms in an industry face, such as consumer preferences, industry standards, and inputs of production. Porter (1980:28) developed the most widely accepted model for analyzing the industry or competitive environment. He proposes that an industry's state of competition is decided by the interaction of five forces: threat of entry, power of suppliers, power of buyers, threat of substitution, and intensity of rivalry. These forces are illustrated in Figure 3-2.

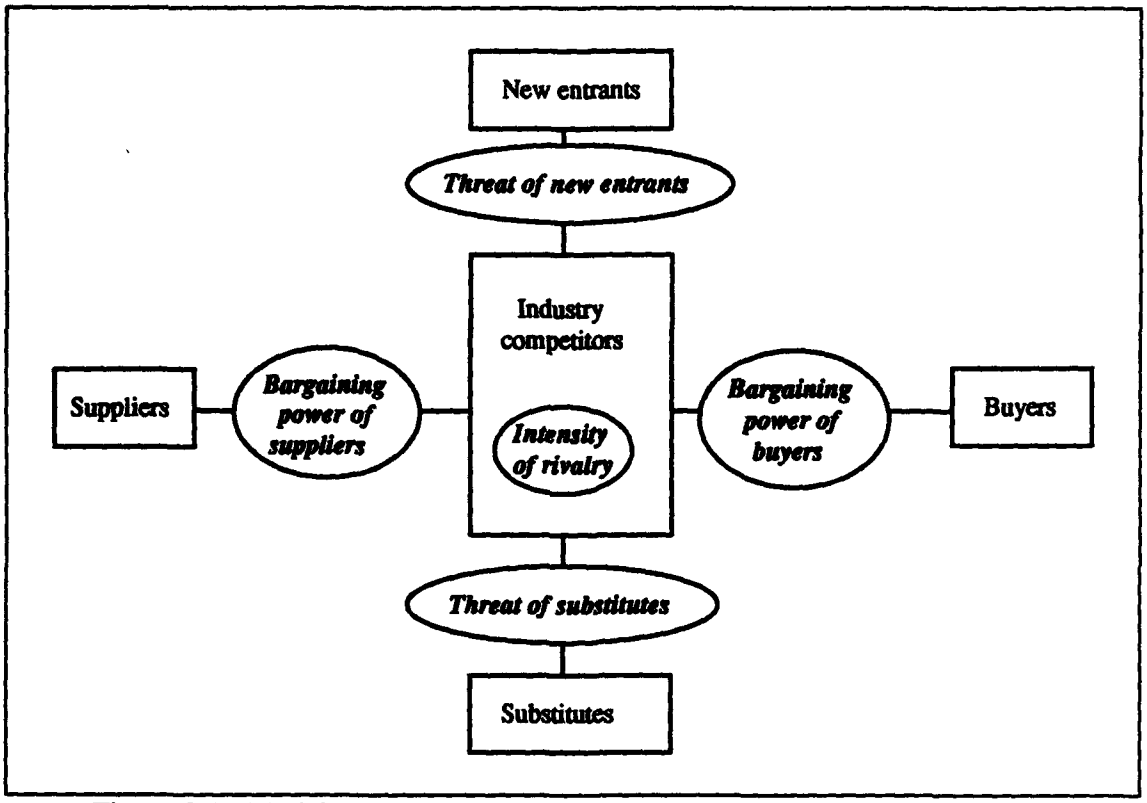

Figure 3-2. Model of the Industry Environment (adapted from Porter, 1980:4)

Porter maintains that these five forces are the most important characteristics of an industry's environment. When an organization is developing its strategy, it should focus its attention upon these forces. It is not the individual strength of each force that impacts the potential for an industry's success, but rather the collective strength of all the forces. An organization conducting an environmental analysis can use the five forces of this model as a framework to describe the forces impacting the organization from the industry environment.

The macroenvironment is the broadest level of the environment and is also termed the "general environment" or "political economy." This level affects all industries, albeit in different ways. Examples of factors in the macroenvironment include inflation, interest rates, and antitrust laws. Fahey and Narayanan (1986:220) devised a model which divides

the macroenvironment into four segments of analysis: social, political, technological, and economic. Their model is represented in Figure 3-3. An environmental analysis gathers intelligence on trends that may impact the organization in each of these four segments.

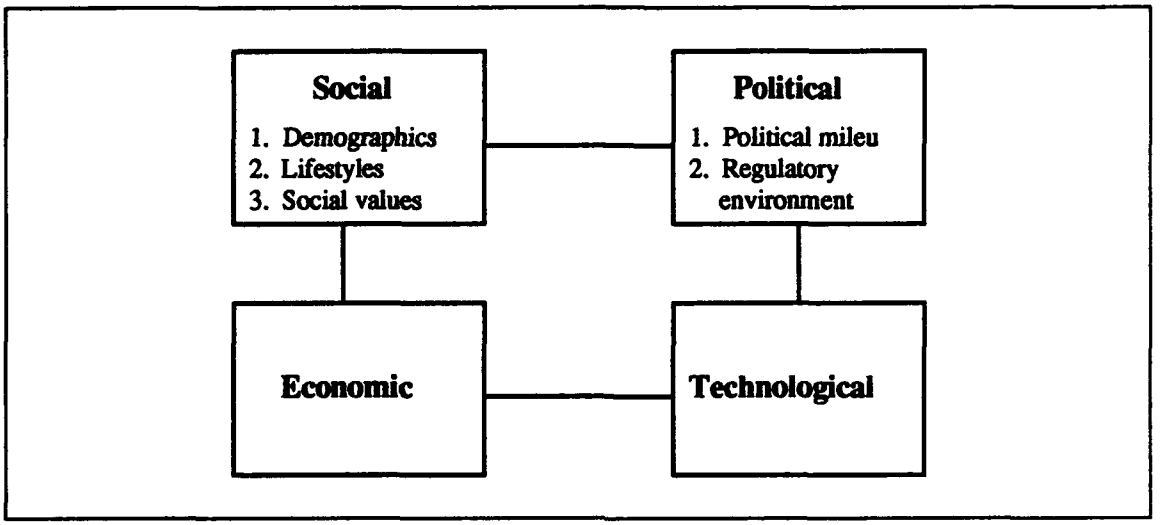

Figure 3-3. Model of Macroenvironment (Fahey and Narayanan, 1986:220)

Environmental analysis focuses on the macroenvironment and industry environment levels, and builds the foundation for strategic plans which affect the task environment. Figure 3-4 graphically shows the interrelationship among the levels of environment.

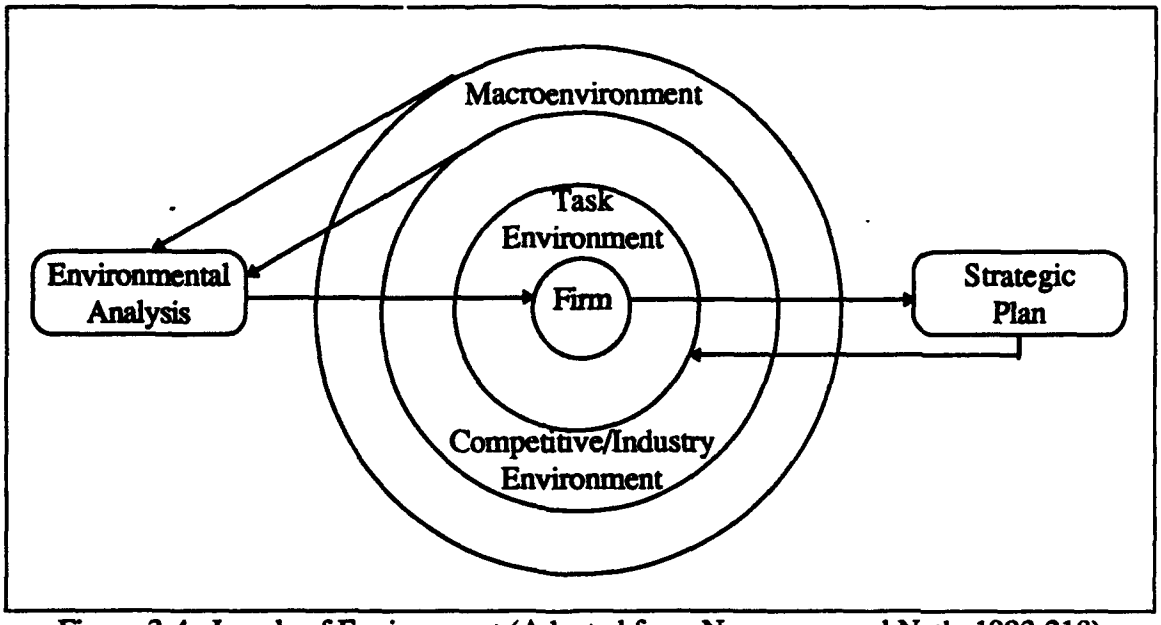

Figure 3-4. Levels of Environment (Adapted from Narayanan and Nath, 1993:218)

Figure 3-4 depicts the relationship that both the macroenvironment and competitive/industry environment have on the environmental analysis that an organization conducts. This analysis then impacts the strategic plan that a firm develops, which, in turn, affects the task environment of the organization.

Characteristics of Environments. A major goal of environmental analysis is to manage the uncertainty of the future. The higher the uncertainty about environmental changes, the greater is the risk of strategy failure. In a classic study, Duncan (1972:316) developed a typology to outline two dimensions of uncertainty: environmental complexity and environmental change. The level of environmental complexity, which ranges from simple to complex, refers to the number of dissimilar elements in the environment that are relevant to the organization. A simple environment (such as that of a local, stand-alone drugstore) may be influenced by only two or three external elements, such as suppliers,

customers, and competitors. A complex environment is typified by a university, which is influenced by a large number of dissimilar elements (government, alumni, parents, foundations, and professional associations).

Environmental change is described by a stable-dynamic dimension, which classifies an environment based on the stability of its elements. The corner drugstore in a small town experiences a stable environment, in which the influential elements stay the same for a period of time. A computer firm, on the other hand, faces a dynamic environment, with a steady stream of new products and technology, changes in customer preferences, and unpredictable actions of competitors. Table 3-1 illustrates Duncan's typology by outlining the two dimensions of uncertainty.

Table 3-1. Typology of Organizational Environments (adapted from Duncan, 1972:320)

	Environmental Complexity	
Environmental Change	**Simple**	**Complex**
Stable	1. Small number of similar external elements. 2. Elements change slowly. *Low uncertainty.*	1. Large number of dissimilar external elements. 2. Elements change slowly. *Low-Moderate Uncertainty.*
Dynamic	1. Small number of similar external elements. 2. Elements change frequently. *High-Moderate Uncertainty.*	1. Large number of dissimilar external elements. 2. Elements change frequently. *High Uncertainty.*

Duncan (1972:319) draws two conclusions about uncertainty facing an organization. First, he argues that uncertainty is lowest for an environment that is simple and stable, and highest for one that is complex and dynamic. Moderate uncertainty is experienced in environments that are either simple-dynamic, or complex-stable. Second, he finds that the stable-dynamic dimension has more impact on the level of uncertainty than the simple-complex dimension. Dynamism is more difficult to manage than complexity, which leads to the conclusion that a simple-dynamic environment generates more uncertainty than a complex-stable environment.

Emery and Trist (1973:41) identify four types of environments an organization may encounter. These environments are based on the complexity and change that the organization may confront. The first, "placid-randomized environment," is the least threatening to the organization because it is the most stable. This environment is similar to a state of pure competition in which there is little an organization can do to affect the market. Within this environment, change is slow and random; therefore, the environment is not considered in the decision-making process.

The next environment is the "placid-clustered environment." Here, the changes also occur slowly but they occur in clusters rather than in a random pattern. Clustered changes signify that forces within the environment are interrelated. Here it is more important for the organization to know their environment than when threats were random (Emery and Trist, 1973:45).

The third environment is the "disturbed-reactive environment." Here the complexity of the environment begins to increase. There may be one or more companies

that are strong enough to control the environment and the organizations within it. To survive, companies in this environment must plan their initiatives and be able to counter the actions of other companies (Emery and Trist, 1973:48-49).

The last environment is the "turbulent-field environment." This environment has the most uncertainty and dynamism in which change is constantly occurring and the variables in the environment are highly interrelated. To survive, companies must continually produce new products or services and reassess their relationships with suppliers and customers (Emery and Trist, 1973:52-53).

Daft (1989:129-130) builds upon Duncan's work by creating a contingency framework for organizational responses to uncertainty. He describes five types of responses, which are listed below as they apply to an environment of high uncertainty (a dynamic and complex environment).

1. Environmental Scanning Roles: scanning the environment for trends and changes, and sending information about the organization to other parties in the environment.

2. Imitation: mimicking the managerial techniques, structures, and strategies of successful firms in the same industry.

3. Planning: making forecasts and plans to deal with the uncertainties of the future.

4. Organizational Structure: increasing the specialization of and coordination between departments.

5. Nature of Control Process: decreasing the amount of formal structure in the organization.

Daft concludes that a careful, organized approach to environmental analysis is less important for stable environments, but essential for environments with a high level of uncertainty.

Components of the Environmental Analysis Process. Narayanan and Nath (1993:219) state that the process of environmental analysis can be conceptually divided into four stages: scanning, monitoring, forecasting, and assessment. Scanning is surveillance of the environment in which environmental changes are sought out. Scanning identifies issues that will impact the organization in both the short term and the long term. It is a loosely structured activity, since relevant information may turn up in the unlikeliest of places. The data generated at this stage is often ambiguous and disconnected, and is the input for the next stage in the process of environmental analysis, monitoring.

Monitoring is the systematic tracking of the elements identified in the scanning stage. The research at this stage is focused and systematic, and will generate a precise description of the environmental trends to be forecast (Narayanan and Nath, 1993:219).

Forecasting projects the direction, intensity, speed, and scope of the development of trends identified in the monitoring stage. The forces driving a trend are unearthed and are used to predict possible outcomes in the future. Assumptions and projections of the forecast are also delineated in this stage (Narayanan and Nath, 1993:219).

Finally, the assessment stage moves the environmental analysis from forecasts of events in the environment to their impact on the organization. The implications for the organization are explored, including strategy, structure, and relevant organizational

characteristics (Narayanan and Nath, 1993:219). Figure 3-5 illustrates the relationship between the stages of the environmental analysis process.

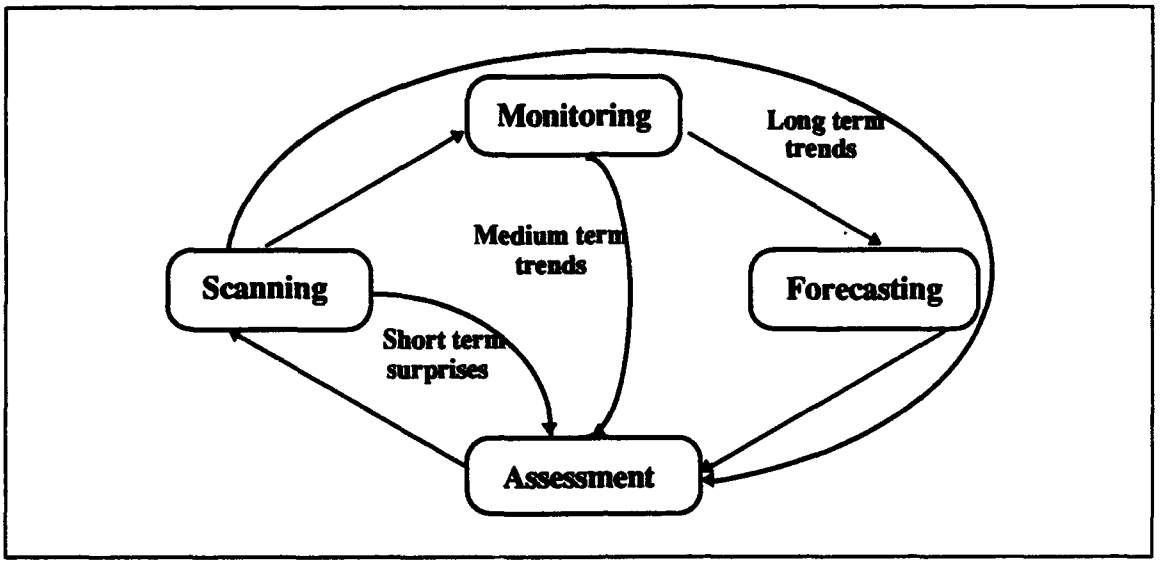

Figure 3-5: Process of Environmental Analysis (Narayanan and Nath, 1993:220)

Output from any of the first three stages can feed into the assessment stage for immediate application based on immediacy. Short term "surprises" discovered in the scanning stage that must be dealt with quickly jump ahead into the assessment stage. Medium term trends discovered in the monitoring stage that will happen near enough in the future that forecasting is not necessary can also skip ahead to assessment. Long term trends work through each stage of the environmental analysis cycle (Narayanan and Nath, 1993:220).

Forecasting

The Importance of Forecasting. Holroyd (1979:108) states that forecasting is "the search for those forces which partially control our future and for the pathways in which we may maneuver and create options." Forecasting is an essential element of both the strategic planning and the environmental analysis processes. "Almost everything written about planning stresses the importance of accurate forecasting.... Planning depends on an ability to predict where that environment will be during the execution of the plans" (Mintzberg, 1994:228). Although many methods of forecasting are available, forecasting is not always a very reliable field. "Long-range forecasting (two years or longer) is notoriously inaccurate" (Hogarth and Makridakis, 1981:122). However, there is a great need for accurate long-range forecasts. Gimpl and Dakin (1984:125) believe that management relies heavily on future-oriented techniques to relieve anxiety and build confidence about decision-making, to unite managers, and to prompt them to take action.

> The ability to forecast accurately is central to effective planning strategies. If the forecasts turn out to be wrong, the real costs and opportunity costs...can be considerable. On the other hand, if they are correct they can provide a great deal of benefit. (Makridakis, 1990:170)

Categories of Forecasting Methods. Forecasting methods can be divided into two broad classifications: quantitative and qualitative. The quantitative methods can be further divided into two categories: causal and time series. Causal models can be used if relationships between variables of interest are known. One type of causal model is the econometric model. These models are "simultaneous systems of multiple regression equations" (Pearce and Robinson, 1983:7). Other causal models use simple or multiple

regression, which identify correlation's between variations in independent variables and dependent variables. The regression models are less expensive and less complex than the econometric models, but still popularly used.

The other form of quantitative forecasting model is the time series model, which identifies trend, seasonal, and cyclical patterns in historical data and uses them to predict the future. Time series techniques include exponential smoothing, decomposition, and trend extrapolation. These models are often less expensive and less complex than the causal models. The time series models are limited by their foundational assumption that the future will be a continuation, in some form, of the past.

Qualitative or judgmental forecasting approaches are particularly useful when historical data alone may not be a good predictor of the future, or when historical data is unavailable or difficult to use. There are several approaches to qualitative or judgmental forecasting. One method is the salesforce estimate, which compiles an aggregate of salespersons' forecasts. Juries of executive opinion are obtained by having marketing, production, and finance executives jointly prepare forecasts. Anticipatory surveys and market research forecast sales by surveying the intentions of potential customers. The Delphi method guides experts in iterative rounds to a consensus. Brainstorming is a method to generate ideas in a group situation without the negative force of criticism. Finally, scenarios are used to forecast future conditions as participants construct stories about the future that integrate objective and subjective parts of other forecasts (Pearce and Robinson, 1983:8). The key characteristics of scenario analysis that distinguish it from other forms of forecasting are the qualitative, contextual description of the future

environment, and the identification of several possible futures. Additionally, scenario analysis can include several other aspects of strategic planning, such devising and testing strategies, thus making it more than just a simple forecasting technique.

Table 3-2 compares several forecasting methods in terms of cost, popularity, complexity, and the stage of life cycle for which the method is most frequently used.

Table 3-2. Popular Approaches to Forecasting, adapted from Pearce and Robinson (1983:7)

Technique	Cost	Popularity	Complexity	Association with Life Cycle Stage
QUANTITATIVE				
Econometric Models	High	High	High	Steady State
Single and Multiple Regression	High/ Medium	High	Medium	Steady State
Trend Extrapolation	Medium	High	Medium	Steady State
QUALITATIVE				
Salesforce Estimate	Low	High	Low	All Stages
Juries of Executive Opinion	Low	High	Low	Product Development
Anticipatory Surveys	Medium	Medium	Medium	Market Testing and early Introduction
Delphi	Low	Medium	Medium	Product Development
Brainstorming	Low	Medium	Medium	Product Development
Scenarios	Varies	Medium	Varies	All Stages

Quantitative Forecasting vs. Qualitative Forecasting. Several strategic planning experts warn about the dangers of relying too heavily upon quantitative forecasts. One of the major problems with traditional quantitative forecasting methods is that it bases

its outcomes on only one set of assumptions; therefore the forecast is only as accurate as its underlying assumptions. With today's dynamic environment, one should expect that there are a variety of possible outcomes (Schnaars, 1987:106). Ascher (1978:5) states another cause for error in quantitative methods is the incorrect determination of assumptions. For example, Schnaars and Berenson (1986:73) found that the forecasts for "fantastic innovations" of the late 1960s were inaccurate. These forecasts were stimulated by the assumptions that the economy would continue to grow and that the space program would continue to receive large amounts of funding.

Dimma (1985:25) cautions planners to "be skeptical, though not cynical, about all forecasts." Extrapolations are highly suspect because they are usually based on erroneous, simplistic assumptions. Computer-driven models "convey a spurious air of authenticity to the exercise but are based on no-less-suspect assumptions than any more mundane approach." Although he accedes that simple extrapolation works well enough to predict the future in stable environments, Mintzberg (1994:236) believes that forecasting becomes less and less reliable as the environment under study becomes more uncertain. The major difference between quantitative and qualitative forecasting methods is that quantitative methods assume history can be extrapolated into the future while qualitative methods assume that conditions can change and that the future may not be explainable by extrapolations of the past (Meristo, 1989:355).

Choosing a Forecasting Method. Several factors must be considered when choosing a forecasting method, such as the nature of the forecast decision, the amount and accuracy of the available information, and the level of accuracy required for the forecast.

Other issues to consider are the time available to make the forecast, the turbulence of the environment, the cost of the forecast, personnel issues and interpersonal relationships of the forecasters, and even the corporate culture (Pearce and Robinson, 1983:9). If time and money allow, more than one method of forecasting can be used to give a more well-rounded forecast.

General Concepts of Scenario Analysis

Scenario analysis is becoming a more frequently used method of forecasting in recent years because of its ability to encompass a number of plausible future environments that may be encountered, rather than relying on a single estimate of the future that may be incorrect.

> Many users of forecasts have become disillusioned with forecasting models that, under the guise of scientific analysis, attempt to predict the future from fancy mathematical manipulations of historical data. This as much as anything has fostered a growth market for scenario analysis. (Schnaars, 1987:105)

Definitions of Scenario. The definitions for scenarios developed throughout the history of forecasting are complementary and build on each other. The term scenario, as used in the context of strategic planning, was reportedly first used by Kahn while working at the Rand Corporation in the 1950s. Kahn and Wiener (1967:6) present an early definition of a scenario as "a hypothetical sequence of events constructed for the purpose of focusing attention on causal processes and decision points." MacNulty (1977:129) further describes it as "a quantitative or qualitative picture of a given organization or group, developed within the framework of a set of specified assumptions." Beck

(1982:18) defines a scenario as an "archetypal description of a possible future based on a mutually consistent grouping of determinants." Bunn and Salo (1993:292) clarify a scenario as "a route through a decision tree, supported by a narrative catalogue of the events and opportunities," although not all branches of that decision tree may be considered in scenario analysis. The term scenarios is also used loosely to describe any forecasting method that generates multiple forecasts (Schnaars, 1987:114).

Although there is general agreement on the definition of the term scenario, there is not consensus as to whether scenario analysis can itself be considered a forecast. According to Millett (1988:61-63), there are two purposes of scenario analysis. The first is to forecast the future in order to make subsequent decisions. Next, "it is used to evaluate the strategic options against the chosen scenario." Focusing on the first purpose, Fischoff (1988:337) views scenario analysis as an extension of forecasting, which uses primarily judgmental methods. Becker (1983:96) concentrates on the second purpose, arguing that scenarios should not be thought of as forecasts, but rather as tools for managers to test the ramifications of decisions under different conditions. Porter (1985:448-449) posits that a scenario is "not a forecast but one possible future structure, based on the identification of uncertainties and their causes, and related assumptions." Scenario analysis can be used as an umbrella to incorporate a variety of forecasting methods, including quantitative models, to generate several feasible futures.

> With the recent emphasis in business forecasting being a synthesis of model and judgment, and the trend toward using multiple forecasts for decision and risk analysis, it is becoming harder to see what is so different about developing a scenario than producing a forecast. (Bunn and Salo, 1993:292)

The differences between scenarios and forecasts (as they have been traditionally used in the past) are contrasted by Beck (1992:18):

1. A forecast is a statistical compilation of probabilities and "expert opinion," while a scenario is a model describing a possible future arising from a particular combination of variables.

2. A forecast is considered to have taken all factors into account to determine the one best answer. The forecast is an authoritative, "'front line' judgment in itself, and tends to dictate the final decision," removing much of the responsibility for a decision from the decision-maker. A scenario presents key factors that should be considered and the possible impact they may have on the future, assisting understanding and facilitating decision-making.

3. Forecasts typically bring a quantitative approach to planning, while scenarios bring a primarily qualitative approach.

4. A forecast stands on its own, to be considered, accepted, or rejected. A scenario is meaningful only in conjunction with other scenarios.

5. The basic philosophies of the two approaches are different: the forecasting approach is based on the belief that the future can be measured and controlled, while the scenario approach assumes that the future is uncertain and may take one of any number of paths.

Beck further states that scenario analysis provides solutions to the problems of traditional forecasting methods by focusing the managers' attention on a set of narratives describing different, feasible futures. The scenario approach can help managers grasp the role of uncertainty and make informed decisions that will encompass a range of possible developments.

Scenario Analysis Performance. Schnaars (1987:110) reports scenarios are being recommended over forecasts for long term planning and analysis by management consultants and research journals, and are being applied more frequently in business organizations. The main reason for the growing success of scenarios is the failure of the

trend projection methods of the 1960s to generate reliable forecasts, especially in times of major structural change. He also states that the methodologies of the forecasts were of little importance and that the most frequent reason for errors in forecasts is false underlying assumptions. Most scenario analysis methodologies emphasize the generation of appropriate methodologies.

In an unpublished paper, Schnaars (1983) compared two scenario methods to two econometric models. The comparison was based on the 1983 forecasts of sales for six types of automobile (e.g., subcompacts, full size). Each forecast predicted an outcome for one quarter into the future. During this period the assumption was that the economy was moving from a recession to a recovery. In the final analysis, the scenario methods out-performed the econometric models because they accounted for the high amount of uncertainty and ever-changing historical relationships. According to Klein and Linneman (1981:69), scenarios' ability to anticipate "historyless" events gives them the edge over traditional methods. Whereas traditional forecasting methods only provide a confidence interval around a single future, scenarios advocate the development of contingency plans by demonstrating that there are alternative future outcomes. *Management can then* develop strategies which optimize company performance in light of these alternative scenarios (Huss, 1988:381).

Kahn (1968:170) favored qualitative model building over quantitative methods. *Quantitative model building is based only on aspects that can be quantified, and thus* represents only portions of the forecasting problem. Furthermore, quantitative model building "comes down to a simplistic intuition or an expression of bias rather than a

careful synthesis and balancing of the analysis with more subtle qualitative considerations." Mintzberg cites further problems with hard (quantified) data.

1. Hard information is often limited in scope, lacking richness and often failing to encompass important *noneconomic* and *nonquantitative factors*.
2. Much hard information is too aggregated for effective use in strategy making.
3. Much hard information arrives too late to be of use in strategy making.
4. A surprising amount of hard information is unreliable. (Mintzberg, 1994:258-264)

Qualitative approaches may be "the only practical methods to forecast trends in the political, legal, social, and technological areas of concern.... The same is true for several of the factors in the task environment, especially for customer and competitive considerations" (Pearce and Robinson, 1983:9).

Purpose of Scenario Analysis. Becker (1989:62) cites three main purposes for scenarios. The first is to establish a common background for the groups or individuals involved in developing and choosing strategies for an organization. This is particularly important for large organizations comprising many subunits or elements which are required to propose strategies or budgets. Differing perspectives and competition for limited resources can create suboptimization and hinder the unbiased appraisal of different plans. Scenarios can become a shared point of departure, laying a common foundation for additional planning activities. They can also "stimulate thought about significant possibilities the various operating units may have not considered."

A second purpose of scenarios is to evaluate how well alternative policies and strategies would perform under the conditions described in the various scenarios. Specific

courses of action can be ranked according to potential risks. A strategy that is appropriate for many scenarios would carry less risk. Scenarios can be used to identify methods to make strategies more flexible in responding to changes in the environment.

A third purpose of scenarios is to estimate the impact of a strategy on the environment. A particular strategy and condition in the environment might interact so as to create or prevent the realization of a scenario. Beck (1982:15) explains that forecasts can be self-defeating or self-fulfilling based on their acceptance. A forecast of a future energy crisis, for example, can be self-defeating if citizens believe the forecast and start conserving energy. On the other hand, if a stock market expert predicts a rise in the value of a stock, the forecast can be self-fulfilled as investors flock to purchase the attractive stock, thus driving up the stock's price. Scenarios that trace the development of key drivers can aid in the search for interactions between strategy and the environment.

Bunn and Salo (1993:292) classify the uses of scenario analysis into three schools which have differing objectives. The first school uses scenarios to develop a range of forecasts to assist managers in selecting a strategy. This approach places scenario analysis in the theoretical frameworks of strategic planning and decision analysis. The second school uses scenarios to test a strategy against alternative futures, thus utilizing scenario analysis as a method of risk and sensitivity analysis. In the third school, managers study hypothetical futures to aid learning and for managerial development, using scenarios as creativity and organizational learning tools.

Scenario analysis can also help guide major decisions about new product and market opportunities, capital structure, plant and equipment acquisition, mergers, manpower, organizational planning, and R&D planning (Huss and Honton, 1987:24).

Corporate Use of Scenarios. Linneman and Klein (1983:95) surveyed Fortune 1000 companies and found that 51 percent of them claimed to use scenario analysis. Furthermore, they reported that in 1977 only 22 percent of U.S. companies were using scenario methods. Meristo (1989:355) revealed that the percentage of large European companies that use multiple scenario analysis (MSA) rose from 36 percent in 1984 to 40 percent in 1985. This indicates a significant increase in the use of scenarios by both U.S. and European companies. Scenario approaches were used most often by capital intensive companies with long planning horizons, such as oil companies, vehicle manufacturers, and electricity utilities (Bunn and Salo, 1993:291).

Table 3-3 shows the proportion of scenario users according to type of industry. Petroleum, transport equipment and electrical supply industries use scenarios the most, while the forest, diversified and light chemical companies use scenarios the least.

Table 3-3. Use of MSA by Branch (Malaska, 1985:341)

Branch	Number of users/replies	Proportion of users (%)
Petroleum and related industries	8/12	73
Transport equipment	7/11	64
Electrical supply	5/8	62
Transport	10/18	36
Construction and construction materials	4/11	36
Food manufacturing	4/11	36
Machinery and fabricated metal products	3/9	33
Heavy chemicals	2/6	33
Iron, steel, and ferro alloys	4/13	31
Electrical machinery, apparatus, and supplies	4/12	33
Forest based companies	2/16	14
Highly diversified companies	1/14	7
Light chemicals	0/6	0
Others	5/19	26
Total	**59/166**	**36**

Table 3-4 shows that the size of the company (as determined by asset turnover rate) has an impact on the level of scenario use. The larger the company is, the more it tends to use scenario methods. This relationship may be due to larger companies having resources to conduct scenario analysis, such as funds and planning/forecasting divisions. The high proportion of scenario users in the under $0.5 billion category is due to the transport companies in this group.

Table 3-4. Size of Company by Turnover in 1980 (Malaska, 1985:342)

Turnover ($ billion)	Number of firms mailed	Number of users/replied	Proportion of users (%)
Over 10	31	7/10	70
5-10	48	9/17	53
2-5	139	13/26	50
1-2	201	11/30	37
0.5-1	412	8/46	17
Under 0.5	269	11/37	30
Total	**1100**	**59/166**	**36**

Some people may assume that scenario analysis can be used by only large companies that have endless supplies of personnel, money, and expertise. Although scenario analysis has traditionally been used by larger companies, Foster (1993:123) suggests that small businessmen should use some type of strategic planning approach that deals with the uncertainty the future holds. A study by the Executive Office of the President, 1983 reported that 25-50 percent of small businesses fail within the first twelve months (depending on the definition of 'small'). Foster argues that small businesses could be more competitive by using scenario analysis, and applies the scenario analysis methodology to three small businesses: a restaurant, a home builder, and a Hong Kong entrepreneur.

History of Scenario Use. Table 3-5 shows the average number of articles written per year on the general subject of scenarios. The information was obtained using the ABI/INFORM computer information retrieval system.

Table 3-5. Topic Search for Scenario Related Articles

Term researched	1971-1980	1981-1986	1987-1989	1990-1994
Scenario	22/year	108/year	185/year	280/year
Scenario Analysis	.7/year	2.2/year	5/year	5/year
Scenario Development	.1/year	.8/year	1/year	1.2/year

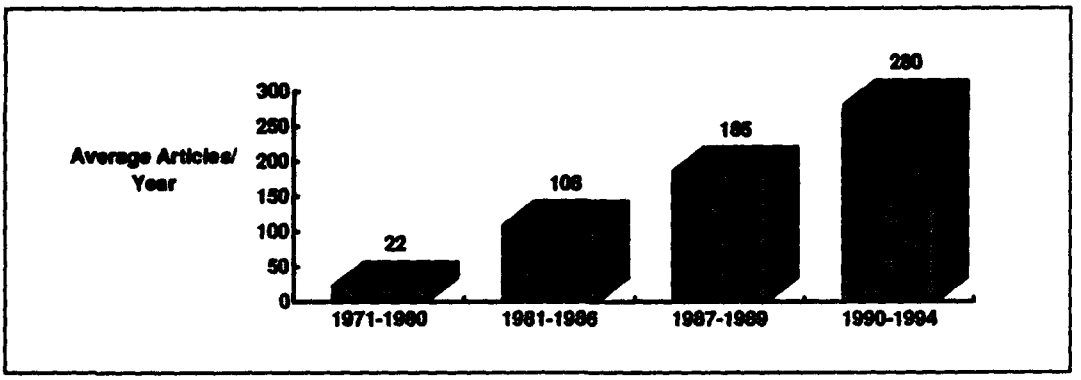

Figure 3-6. Average Articles Written per Year with the Term "Scenario" in the Abstract

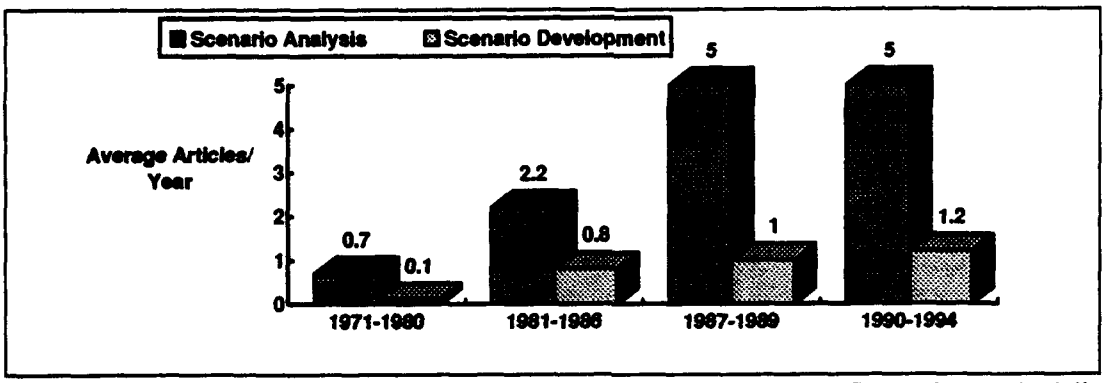

Figure 3-7. Average Articles Written per Year with the Term "Scenario Analysis" or "Scenario Development" in the Abstract

Figures 3-6 and 3-7 indicate that from 1971-1994, there was a substantial increase of articles written on the subject of scenarios. Under the term "scenario," the number of articles written increased nearly thirteen times, possibly indicating that the general concept of using scenarios to manage the future is becoming more popular, while "scenario analysis" and "scenario development" articles written increased seven and twelve times respectively.

The introduction of scenario analysis methods into an organization may be related to the organization's amount of experience with strategic planning processes. Nearly half of the users of scenario analysis methods had a formal strategic planning system prior to 1970 and a quarter of the users had a planning process before 1965. Figure 3-8 shows that scenario users have more experience with strategic planning than non-users do. Malaska (1985:345) reports that companies obtaining the maximum benefits from scenario analysis usually have a large degree of strategic planning experience. Scenario analysis serves in a supporting role for strategic management.

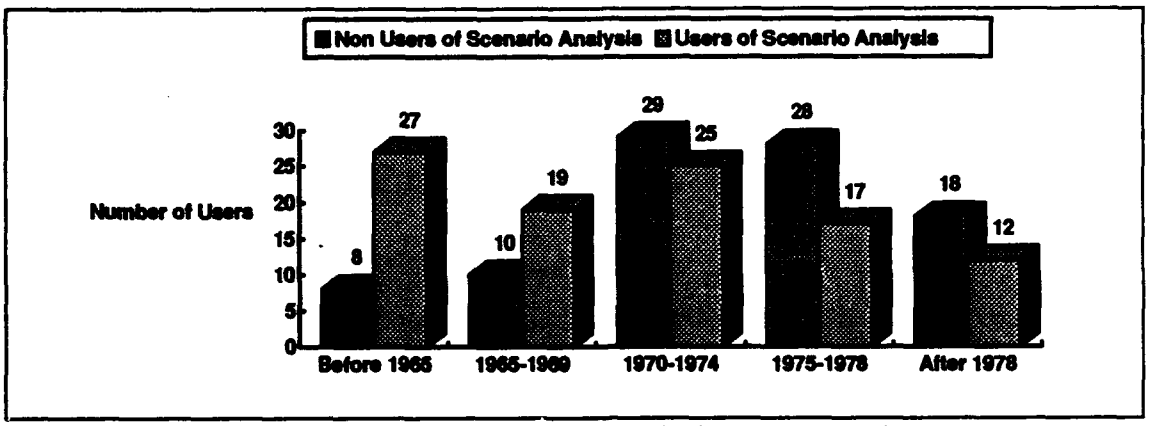

Figure 3-8. Length of Experience in Strategic Planning
(adapted from Malaska, 1985:345)

Scenario analysis is a flexible technology that can be applied to many topics and time frames. For example, a study of United States and United Kingdom (U.K.) scenarios for energy policies showed that the time and money spent on scenario development can differ significantly. The U.S. study cost millions of dollars and lasted two years, while the U.K. study used desk calculators and recent literature to develop its scenarios within six months (Chapman, 1976:4). Scenarios can be used to describe environments on many levels, from a global environment to that of an individual organization.

Many studies have been published that describe the application of scenario analysis in different contexts, including:

A scenario of U.S. government-corporate relations
Scenarios in U.S. defense planning
Studies of technological choice in North-South development
Studies of political risk in oil-producing countries
Studies of sales behavior in different markets
A single scenario of post-industrial Canada
Long-term energy scenarios
Studies of investment portfolio management alternatives
Effect of ultra-high voltage power transmission lines
Technology transfer in developing countries

Strategies for investment of pension funds
Future development of U.S. States
Relationships between companies and nations
U.S. energy use in buildings in the next two decades
(Zentner, 1982:14)

Sources of Information About Scenario Analysis. There are three sources of information upon which scenario analysis is built. One source is empirical studies that focus on topics related to scenario analysis. These topics have a wide range of applications and support the concept that scenarios are valuable forecasting tools. Another source of information comes from companies that have used scenarios. Some of the most prominent companies that use scenarios are Royal Dutch/Shell, Georgia Power Company and ARCO. Individuals who had a role in the development of scenarios within these companies wrote articles for business journals, presenting many valuable heuristics for scenario construction. Literature in the area of futures research describes scenario construction methods, ranging from qualitative to quantitative procedures (Schnaars, 1987:105).

Who Should Develop the Scenarios? According to Becker (1989:63), scenarios are limited if one individual develops them for the organization. These scenarios will be limited by the individual's personal opinions and biases rather than being the product of a systematic methodology. They often have internal inconsistencies and predict mutually exclusive events that cannot happen in a certain sequence, or events that cannot both occur at the same time. Identifying and removing the inconsistencies is particularly difficult for a lone author. Instead, scenarios should be developed by various people within the organization. Great benefits are realized by involving people with different

viewpoints in the development of scenarios. The resultant scenarios encompass a greater range of possibilities and are more realistic. Also, the people involved in the process can understand the methods used in formulating the scenarios, and are more likely to accept and use the results in their business decisions.

Advantages of Scenario Analysis. The advantages of scenario analysis can be divided into three broad categories. These categories can be further subdivided into more discrete advantages.

They Demonstrate to Management the Range of Outcomes.

1. Becker (1983:96) states that scenarios not only show positive outcomes, but they also make evident the outcomes which are undesirable to management. Many times organizations feel uncomfortable about planning for futures which may be damaging to them. Scenarios portray these threats and force the organization to pay closer attention to these negative scenarios.

2. Linneman and Klein (1985:66) report that multiple scenarios give management an idea of the degree of uncertainty in the future environment. This may prohibit management from locking into a specific environment and it can encourage them to develop contingency plans and to perform risk analysis.

3. Scenarios give insights on the business dynamics of the organization. Although they will not provide managers with the timing of structural changes, they give an understanding of the business dynamics, trends to monitor and ranges of possible future outcomes (Huss 1988:381).

Scenarios Give Management Flexibility in Planning.

1. A variety of scenario generating procedures are "user-friendly." The procedures range from informal to formal, and the degree of formality can be suited to the situation (Linneman and Klein, 1985:66).

2. Scenarios can show the interaction between variables, allowing management to use a more adaptive mode in planning (Linneman and Klein, 1985:66).

3. Scenarios enable an organization to determine their market position within the operating environment. They allow the organization to have an external view instead of an internal view, thus emphasizing a market and customer orientation (Huss 1988:381).

4. Scenarios are flexible enough to allow the incorporation of other forecasts. Techniques such as econometric modeling, trend analysis and Delphi can be used to develop a scenario (Linneman and Klein, 1985:66).

5. Scenarios integrate not only quantitative inputs, but also qualitative inputs such as regulatory issues and world politics into the forecasting process (Linneman and Klein, 1985:66).

6. By testing the effects of alternative events, scenarios promote sensitivity analysis. For instance, they can be used to test the effect of low probability, high impact events such as the assassination of a world leader or an increase in terrorist activity. Many scenario methods allow these events to be depicted using computer models, while other methods depend on the knowledge of the development team (Huss 1988:381).

They Enhance the Human Resource Aspects of an Organization.

1. Scenarios encourage communication between organizational departments by forcing them to interact on various issues. Though the departments may not agree on a particular scenario, they do provide a basis upon which planners and management can evaluate the key decisions (Huss 1988:381).

2. By using group processes such as the Delphi method and nominal group technique, scenarios build team spirit and consensus. These processes increase both the organizational communication and the understanding that shared concerns are to be achieved (Huss 1988:381).

3. Scenarios give rise to creative ideas as a byproduct of enhanced organizational communication methods (Huss 1988:381).

Disadvantages of Scenario Analysis. Though scenario analysis has many advantages, it still has some drawbacks that need to be addressed, including the following.

1. Scenario developers may be overconfident in their judgment and may develop scenarios that are least likely to counter their ideas.

2. Developers may be\overconfident in the amount of influence they have over events (Bunn and Salo, 1993:299).

3. A well-thought out and detailed scenario can seem more probable to users than its companion scenarios because of the completeness with which it is described. In reality, the scenarios may have equal probability. To resolve this problem, the presentation of scenarios should be set in a standard format. For example, each scenario should be allotted the same amount of time, level of detail and intensity of investigation (Fischoff 1988:337).

4. Amara (1988:390) states that managers must be aware of information overload. Sjoberg (1982:350) warns that excessive information gathering may have a detrimental effect on the quality of the decisions while the confidence of the decision makers increases.

5. Schoemaker (1993:209) also identified other negative aspects of the scenario approach such as a relatively steep learning curve, organizational culture shock and the new challenges of moving from multiple scenarios to one strategy, budget or plan.

Classifications of Scenarios. The construction of scenarios can be approached in different ways. Several classification schemes can be applied to these different approaches. Ducot and Lubben (1980:51) classify scenarios as exploratory or anticipatory. Exploratory scenarios start in the present time and extend the time horizon little by little, describing future conditions based on the consequences of current actions. This approach is similar to tracing the branches of a decision tree, and fits the natural human orientation to time of forward inference. The resultant scenarios are likely to be realistic, but not surprising. This cause-effect approach identifies outcomes that are the consequence of an easily identifiable antecedent, and may not generate outcomes that would result from more complex causes. Becker (1989:63) states that using the exploratory approach "presents major intellectual barriers to uncovering significant, meaningful interruptions to historic patterns." In practice, it is much more effective to use the normative approach (or what others call the anticipatory approach).

Anticipatory scenarios presume a future condition and search for possible causes using backward inference. The authors specify a set of future conditions and then detail the sequence of possible steps leading up to those conditions. The emphasis is placed on finding explanations rather than consequences, and often results in the discovery of new options and surprising twists. Jungermann (1985:326) asserts that the most reliable approach is to blend exploratory and anticipatory methods, yielding comprehensive scenarios without accidental omissions.

Ducot and Lubben (1980:51-54) also classify scenarios along two axes. The first axis ranges from descriptive to normative. Descriptive scenarios describe future conditions without assigning the value or desirability to a particular state. Normative scenarios include the user's goals and interests.

The second axis rates a scenario on how surprising the scenarios appear to be. Trend scenarios are extensions of the present into the future (emphasizing an exploratory approach), whereas peripheral scenarios develop more surprising outcomes by assigning extreme values to input variables (a more anticipatory approach).

Schnaars (1987:106) classifies scenarios as either deductive or inductive. Deductive scenarios, which are similar to exploratory scenarios, are created by setting an optimistic or pessimistic theme and assigning relative values to the variables. This approach is likely to produce internally consistent scenarios, but limits the number of possible outcomes. The inductive approach begins by identifying major factors and their possible outcomes, and then combines outcomes to generate scenarios. This approach is

more comprehensive, but may omit a key factor or produce scenarios with conflicting outcomes.

A scenario can be longitudinal, developing a progression from the present into the future, or cross-sectional, describing the condition of the environment at a set time in the future (Schnaars, 1987:106). Becker (1989:62) describes the same classifications in laymen's terms: future history and time slice, respectively. He claims the future history approach is more useful for setting business policies, because strategies being considered can impact the evolution of events, and must be compatible with the conditions leading up to the future environment. Thus, the cause-and-effect information provided by the future history approach can help generate more robust strategies.

Scenarios can also be described as primarily qualitative or quantitative. Purely qualitative methods are more commonly used (*Bunn and Salo, 1993:293*), but quantitative reasoning has been incorporated through the use of trend-impact and cross-impact analysis.

In another study, Linneman and Klein (1985:66) identified five basic types of scenarios which are categorized as global external, industry/business-specific, exploration, issue-oriented and external assumption scenarios. Some companies may use only one type, while others may use all five types. The types and the degree to which they are used are dependent on factors such as the complexity of the organization, the organization's familiarity with scenarios, and the attitude toward scenario analysis.

Global (external) scenarios are made up of variables such as the GNP, consumer attitudes, geopolitical trends and potential major structural shifts in international

socioeconomic conditions. These types of scenarios show the interaction among variables. Global scenarios are used primarily at the corporate level to determine resource allocation or as benchmark assumptions for business unit planning (Linneman and Klein, 1985:66). Huss (1988:379) asserts that there is an increasing need for scenario analysis of the macro environment. For example, an econometric model of energy consumption may include independent variables such as population, income and employment. Typically, these forecasts are developed independently and are used to forecast the consumption of energy. However, these forecasts interact with each other and can synergistically impact the future.

Industry/business-specific (external or external/internal) scenarios give an overview of the different external factors that are significant to an organization. They demonstrate the interdependencies among the variables. For instance, they may show how the sequence of events within the scenario affects one another and the timing of the interactions. They are especially useful when the organization has identified the area of interest in which it will compete. They can be generated at either the corporate or managerial level (Linneman and Klein, 1985:66-67).

Exploration scenarios look beyond the current industry and are more focused than global scenarios. They are useful for exploring new opportunities, but difficult to develop because they involve investigation of unknown environments (Linneman and Klein, 1985:67).

Issue-oriented (external) scenarios identify the external variables and evaluate them based on different measures of performance. There may be three scenarios in which each

is generated under certain conditions such as optimistic, current and pessimistic. Issue-oriented scenarios are useful when companies have identified issues that are so specific that all other considerations are disregarded (Linneman and Klein, 1985:67).

External assumption (internal) scenarios are the least sophisticated types of scenarios. They are used to investigate the internal actions of the company. The variables making up the scenario are internal to the company (Linneman and Klein, 1985:67).

Table 3-6 recommends which of the five types of scenarios listed above should be used, based on the company structure and planning task.

Table 3-6. Scenario Selection, by Type of Company and Planning Task (Linneman and Klein, 1985:71).

	Planning Task				
Company Structure	**Allocate Corporate Resources**	**Point of Departure (Background for Business Units)**	**Identify New Business Opportunities**	**Evaluate Business Units' Plans**	**Evaluate Specific Projects**
Single Business	Global	N/A	Exploration, Global	N/A	Industry, Issue-oriented, External Assumption
Dominant Product Line, Other Businesses Are Related	Global, Industry	Industry, Global	Exploration, Global	Industry, Issue-oriented, External Assumption	Industry, Issue-oriented, External Assumption
Dominant Product Line, Other Businesses Are Unrelated	Global, Industry	Global, Industry	Exploration, Global	Industry, Issue-oriented, External Assumption	Industry, Issue-oriented, External Assumption
Diversified Structure	Global	Global	Exploration, Global	Industry, Issue-oriented, External Assumption	Industry, Issue-oriented, External Assumption

Linneman and Klein (1985:70) state both global and external assumption (internal) scenarios are used the least in this scenario selection table. Global scenarios are too closely related to conventional economic forecasts. They are used only as a foundation upon which industry/business-specific scenarios are developed. External assumption scenarios are usually financially oriented and are designed to evaluate capital projects. These types of scenarios are less realistic at the business-unit level and therefore are used less.

Exploration scenarios are outstanding vehicles for scanning the environment for business opportunities. This type of scenario works best with a focus on a narrow segment of industry. If an organization is faced with simultaneous resource allocation decisions, an industry/business-specific scenario is most appropriate. If the organization must deal with more than one external issue, then issue-oriented scenarios should be used. These scenarios must be used with caution because of the tendency to focus on the issues that are currently affecting the organization. For example, during the Vietnam war era, Herman Kahn developed various scenarios that the U.S. could encounter during the 1980s. These scenarios were focused on the Vietnam war; and did not address variables relating to energy, which greatly impacted the 1980s (Linneman and Klein, 1985:71).

The task and structure of the company have a great impact on the type of scenario to be employed. The more diversified the organization, the less the environmental assessment is focused. Business units in diversified organizations typically develop industry/business-specific scenarios and strategies. Management at the corporate level will then evaluate these scenarios and strategies to determine how they will work under

different conditions. In contrast, companies engaged in one type of business often use industry/business-specific scenarios at the corporate level (Linneman and Klein, 1985:71).

Scenario Analysis Methods

Scenario generation methods can be divided into two broad categories: qualitative and quantitative. The processes within each of these methods range from simple to highly complex. The simpler methods may require only the knowledge of the individuals within the organization, while the more complex methods may use computers, complex quantitative techniques, and external consultants.

Qualitative Methods. This section discusses the various scenario analysis methods that use qualitative means to actually construct the method, although quantitative techniques may be applied in other steps of the scenario analysis process. It begins with the less complex methods and ends with the most complex qualitative method, intuitive logics. The major advantage of using these qualitative methods is that they do not force the quantification of qualitative issues. Another advantage to using qualitative methods is that they develop shared insight, communication, and organizational learning of the individuals involved (Becker, 1989:64-69).

Foster. Foster (1993:125) proposes a construction model that focuses on the small business sector. The model is purposefully simple to accommodate the modest budgets of small businesses. There are five steps to the model.

1. Identify key factors. Factors internal and external to the organization should be included.
2. State the assumptions along with the time horizon.
3. Identify sources of information for the key factors.

4. Identify the issues and points of divergence arising from conflicting forces in the current situation.
5. Develop the scenarios, perhaps by constructing a simple matrix to analyze the factors and how they affect one another.

Jain. Jain (1986:31) developed a simple method to generate scenarios. This method is further discussed in the "Applications" section of this chapter which gives an example of how scenarios may be developed for a computer company such as Compaq. The difference between this method and other qualitative methods is that it selects the "one" most likely scenario instead of two or three possible outcomes. The method consists of five steps.

1. Define clearly and precisely what is to be forecast.
2. Determine the key issues that are related to the variable to be forecast.
3. Establish the scenarios.
4. With the support of management, select the most likely scenario.
5. Prepare a forecast based on the selected scenario.

Atlantic Richfield. Jones (1985:20) presents a method the Atlantic Richfield Company uses to determine oil prices. The results of this method are discussed in the "Applications" section of this chapter. This unique method bases its econometric forecasts on the scenarios developed. The process also contains a feedback loop that analyzes the issues, risks and opportunities arising from each scenario (see Figure 3-6). These are then compared with the beliefs and assumptions held by the organization.

1. Determine what critical decisions must be made -- develop a framework.
2. Develop trends of key variables.
3. Select "forces for change" which impact the trends.
4. Create scenarios.
5. Develop forecasts for each scenario.

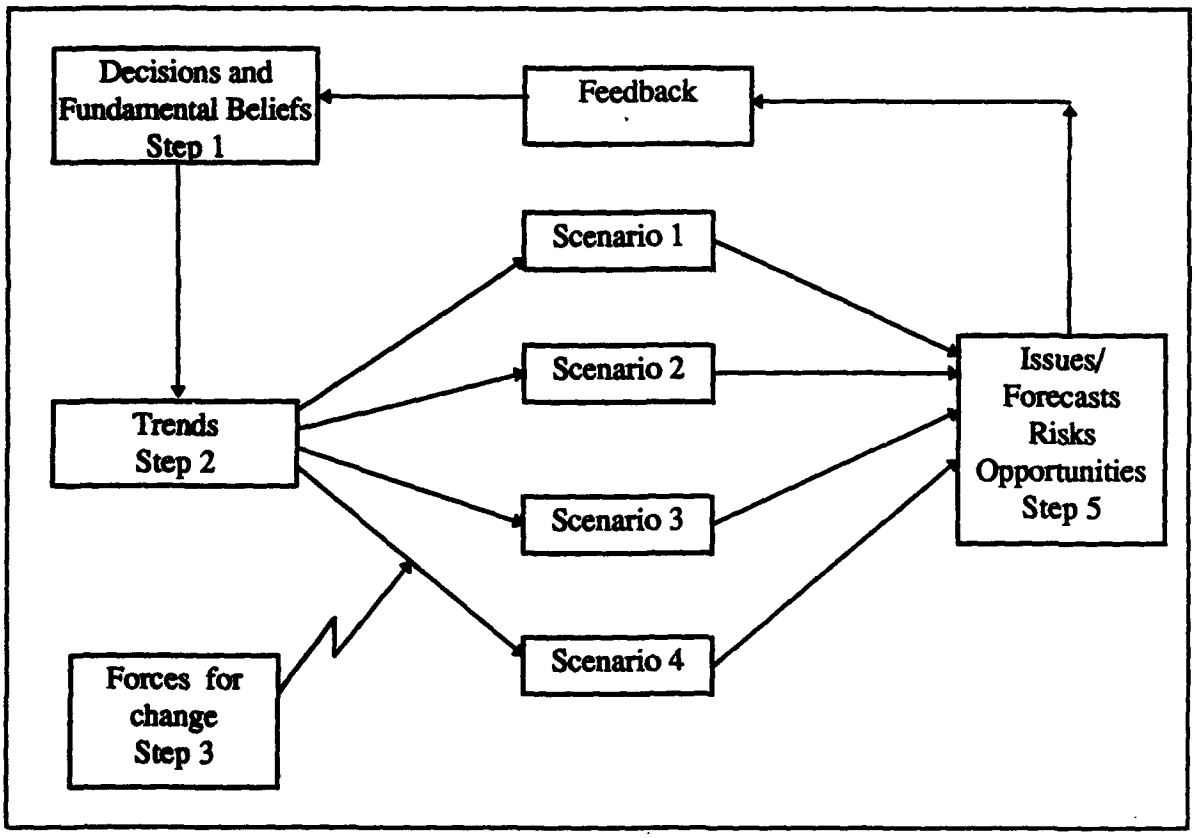

Figure 3-9. Building Scenarios (Jones, 1985:20)

Chapman. Chapman (1976:4-5) presents another simple method for exploring the future that is rooted in the assumption that "the future is a matter of choice and can be influenced by policy decisions." The steps in this proactive scenario development model are:

1. Determine the purpose of the study.
2. Choose a timescale and scene years.
3. Decide on the number of branches and options to be discussed.
4. State the philosophy of each option.
5. Construct snapshot views.
6. Conduct a consistency check.
7. Set a policy time series, check for time lags.
8. Test for robustness.
9. Conduct additional evaluation.
10. Draw conclusions.

Becker. Becker (1989:64-69) presents an eight-step methodology for scenario construction and application that have been implemented in several organizations for which he is a consultant. This method is different from other qualitative techniques because it incorporates trend projections into its methodology. The eight steps are:

1. Select the drivers. These are the basic scenario characteristics that shape the environment in question.
2. Set the range of values for the drivers. The range should represent the issues that manifest the organization's characteristics and any discontinuities from past trends.
3. Select the specific scenarios to be developed such as most likely, pessimistic and optimistic scenarios.
4. Choose trends/indicators (the details).
5. Prepare projections for each scenario.
6. Describe possible future conditions for each scenario.
7. Develop implications for the business for each scenario.
8. Develop promising strategies by considering all the implications.

Schoemaker. Schoemaker (1993:197) developed a ten-step construction process that is designed to be used over the course of a year. One of the unique aspects of this iterative model is that the scenarios are used as learning tools, and the roles of stakeholders are considered. If the scenario is considered to have significant variable interactions, then a quantitative model can be incorporated. For example, simulations can be run to determine uncertainty ranges for key independent variables. Following are the ten steps in this scenario generating process.

1. Determine the topics that need to be comprehended in terms of time frame, scope and decision variables (e.g. price of oil over the next ten years in the Middle East). Conduct a historical review to get a sense of the degrees of uncertainty and volatility.
2. Identify the major stakeholders who will be impacted or will have an impact on the scenarios developed. Determine the stakeholders' roles, interests and power positions.

3. Determine and briefly describe the current trends that will impact the variables. Include in the descriptions how the trends will influence the variables.
4. Identify significant uncertainties that may affect the variables of interest. State why these uncertainties are important and how they relate or impact the variables.
5. Construct a best case scenario and a worst case scenario by separating the positive outcomes and the negative outcomes. Incorporate selected trends into these two forced scenarios.
6. Assess the internal consistency and plausibility of the two scenarios. Show how they may be internally inconsistent in terms of trends or interrelated outcomes.
7. Exclude combinations that are not feasible or credible and create new scenarios (two or more) that are internally consistent and cover a wide range of outcomes.
8. Assess the new scenarios and how the stakeholders would be affected by them. Also identify the issues that require further investigation or may lead to the revision of the new "learning" scenarios.
9. Review the internal consistencies of the learning scenarios and determine whether the variable interactions are significant enough to be incorporated into a quantitative model. If they interactions are strong enough, run a Monte Carlo simulation to determine the range of uncertainty for the independent variables.
10. Reexamine the ranges of uncertainty of the dependent variables of interest and repeat steps 1 through 9 to identify the "decision" scenarios. These scenarios will be used by other members of the organization in their decision making process.

Boroush and Thomas. Boroush and Thomas (1992:29) developed a methodology used by The Futures Group, an international business strategy and policy research firm, for guiding several defense industry firms through the process of scenario analysis. This method is unique because it combines the attributes of qualitative methods and cross-impact methods into three steps:

1. Preparation
2. Development
3. Reporting and utilization.

In the preparation stage, the focus must first be defined. The boundaries for the scenario effort must be drawn, in terms of the major issues being addressed, possible future developments that need to be probed, "indicator variables" which need to be forecasted for good decision making, and the time horizon of the scenarios. Next, the driving forces must be charted. These drivers are the forces and developments that have the greatest ability to shape the future characteristics of the environment.

The development stage covers three main tasks. First, a "scenario space" must be constructed, which is a matrix of the various future states the drivers could jointly produce. Together, these combinations represent a comprehensive set of alternative world scenarios. Combinations that are illogical or highly unlikely to occur can be excluded from the set. Next, the set is narrowed down as a smaller set of alternative worlds is selected to be detailed. Then, scenario-contingent forecasts are prepared. Based on the essential trends and events needed for an alternative world to be realized and its driving assumptions, the trend is projected across the time horizon of the scenarios for each indicator variable identified in previous steps.

The final stage of the Futures Group approach is reporting and utilization. The future history represented by each scenario is documented in charts and narratives. The effective communication of the assumptions and outcomes of each future world are essential for the scenarios to be utilized by managers and planners. Finally, the implications of the alternative worlds are contrasted. Business decisions and planning goals are made, with emphasis given to actions that are the most flexible in light of the described uncertainties. The scenarios may shed insight on what capabilities the

organization needs to perform successfully in each of the alternative worlds. The viability of current plans and strategies can also be tested to see how well they would each perform in the alternative worlds.

Intuitive Logics. Intuitive logics is an approach used by SRI International and Shell Oil that does not depend on computer simulation models to formulate the scenario. Instead, the creativity and knowledge of the development team is used to generate the scenario. This method is founded on the assumption that business decisions are based on complex interrelationships between political, technological, economic, resources, and environmental factors. Insight into these factors can improve decisions regarding strategies, new ventures, new technologies, product development, and capacity expansion. Scenario analysis provides the means for "evaluating the risks, anticipating key moments of change, and identifying tradeoffs between competing company goals" (Huss and Honton, 1987:21). SRI International views scenarios as tools for organizing and defining perceptions about alternative environments which will be the setting for current decisions as they progress into the future. The intuitive logics method consists of eight steps (Huss and Honton, 1987:22-23).

1. Analyze the decisions and strategic concerns.
2. Identify the key decision factors.
3. Identify the key environmental factors.
4. Analyze the environmental forces.
5. Define scenario logics.
6. Elaborate the scenarios.
7. Analyze implications for key decision factors.
8. Analyze implications for decision strategies.

The first step, analyzing the decisions and strategic concerns, considers long range company decisions such as diversification or divestment, facilities investment and market strategies and capital allocation. To ease the scenario development process, a narrow scope of decisions and strategies is sought.

The next step involves identifying the key decision factors. Key decision factors that affect future outcomes are identified. These may involve market size; price trends; and human, energy and environmental resources. To contribute to the quality of decisions made, these factors must be thoroughly researched.

The third step is identifying the key environmental factors. The environmental forces that are identified affect the condition of the key decision factors that were found in step two. The forces are political, technological, social and economic. They are identified using planners and analysts, external consultants, scanning systems, business models and environmental monitoring.

Fourthly, environmental forces are analyzed. Each force is analyzed to ensure that it coincides with the scenarios. Analysis may include a historical review, interrelationships among forces and critical uncertainties.

The fifth step is to define scenario logics. This step is the core of the SRI International approach. "Scenario logics are organizing themes, principles, or assumptions that provide each scenario with a coherent, consistent and plausible logical underpinning." It incorporates the conditions and uncertainties in the first four steps. Scenario logics attempt to describe the situation more than by merely stating whether it is optimistic or pessimistic. Instead, it may describe a future as a buyer's or seller's market.

The sixth step involves elaborating the scenarios. This step involves integrating scenario logics with environmental analyses. The narrative portion of the scenario should focus on the key factors for decision.

Analyzing implications for key decision factors is the seventh step. This step determines the possible results that the scenarios have for each of the key decision variables. Presenting clear and accurate information is the key to this step.

The final step is to analyze implications for decision strategies. A variety of questions are asked in this step to analyze the implications.

1. Does the information about the future validate the original assumptions supporting strategies or proposed decisions?
2. What do the scenarios imply for the design and timing of particular strategies?
3. What threats and opportunities do the scenarios suggest?
4. What critical issues emerge from the scenarios?
5. What special cases deserve to be addressed by specific contingency plans?

The advantage of the intuitive logics method is that it is based on a discerning and logical position. The intuitive logics method is able to create flexible and consistent scenarios. Because it is not based on a mathematical algorithm, it is able to adapt to the needs of the company's environment. Its main disadvantage is that it relies heavily on qualitative aspects which are determined by the experts within the company. This method is less likely to be successful in a scientific environment that requires a more quantitative approach (Huss and Honton, 1987:23).

Quantitative Methods. Qualitative techniques can be highly flexible because they allow for more communication, shared insight and organizational learning. However,

quantitative methods can enrich the qualitative approach using such methods as trend impact analysis and cross-impact analysis.

MacNulty. MacNulty (1977:130) developed an eight step scenario generating method that focuses on a planning horizon of 5-15 years. Due to the time horizon, she structured it for the exploratory type of scenario. This model is a manual version of the cross-impact analysis method in eight main steps.

1. Develop a database.
2. Select the organization's objectives.
3. Evaluate organizational variables.
4. Evaluate environmental variables.
5. Select scenario types.
6. Development or construction of scenarios.
7. Analysis of the implications of the scenarios.
8. Implement the plan.

The first step is to develop a database. The organization gathers historical information that roughly equaling the time horizon for the forecast. For instance, if the organization is forecasting five years into the future, it should collect at least five years worth of historical information. If possible, the data should be presented in graphical form and should include measures of performance such as volume of sales or production. Environmental data should be collected in the same manner, with the measures or trends reflecting variables that may affect the organization, such as the GNP or the rate of population growth.

The second step is to select the organization's objectives. The key to this step is the selection of realistic objectives for the organization. The organization must have the resources required to attain the objective in a timely manner. Once these objectives have

been committed to, they should be pursued until they have been accomplished or abandoned.

Thirdly, organizational variables are evaluated. Variables describe the different operating functions within the organization. They are used to measure the firm's performance and accomplishment of objectives. The variables evaluated should include some of the issues identified in step 1. Examples of these variables are the number of items produced per manweek, or the time that it takes to process an order. Many of the variables identified will not be extracted from the data base. In these situations, historical information about the variable should be collected and included in the scenario.

The fourth step is to evaluate environmental variables. This step is similar to step three. It involves selecting variables that will have an impact on the organization and the achievement of its objectives. These variables may come from within the data base or from the external environment.

Scenario types are selected next. Scenario development provides managers with a "what if" analysis. It allows the managers to make different assumptions about the future and make decisions based on these assumptions. A multitude of scenarios can be developed and used. One of the first scenarios usually developed is the "surprise free" scenario. This scenario is one in which the status quo is used. All changes that will come about are already known. In addition to this scenario, two or three alternative scenarios should be developed.

The alternative scenarios may include a conservative and aggressive approach. The selection will depend on the leadership philosophies and capabilities of top

management. If top management is young and aggressive, the organization will probably take an aggressive posture in developing and selecting its scenarios. On the other hand, if top management is older and more conservative, then the chosen scenario may be more conservative.

Another factor that affects scenario selection is the environment in which the organization is operating. For example, in today's socio-economic environment, a company may decide to use a centrally-planned system or a decentralized system. The selection could have a tremendous impact. If the centrally-planned system is used, then there could be tighter controls and regulations by upper management, whereas a decentralized system could foster less managerial control and more creative thinking.

Sixth, development or construction of scenarios takes place. A matrix is set up and cross-impact techniques are used, such as developing probabilities and estimating the impacts among variables.

The seventh step is analysis of the implications of the scenarios. The impacts of the strategies used to achieve the objectives are analyzed in this step. There are three general possible outcomes. First, the organization just meets its objectives in all the scenarios considered. In this case, the organization is using its resources effectively to achieve realistic objectives. Management may want to reevaluate or raise organizational objectives a little higher. Second, the organization fails to meet its objectives in some of the scenarios. The objectives set in the surprise free scenario are probably realistic; however, one or more of the objectives in the alternative scenarios in which failure occurred is most likely unrealistic. A common fault of many decision makers is to fault

the scenarios rather than the objectives or the strategies. The decision-makers should revisit their original objectives, scenario assumptions, and forecasts to determine the reasons for failure. Once the reasons have been identified and understood, then management can modify or amend the strategies need to achieve the objectives.

Another possibility is that the achievement of the objectives failed in the surprise free scenario but succeeded in the alternative scenarios. There are two possible explanations. First, a manager's perception about the environment may have been at fault. His objectives may be unrealistic, in which case he must modify them. Or, the assumptions about the external environment may be in error. Finally, the organization fails to meet its objectives in all scenarios considered. The organization may not understand its environment or its operational capabilities, or it may have set unrealistic objectives. The organization should restart the process and modify all that is needed.

The final step is to implement the plan. Top management implements the plan. Lower level employees monitor the changes and update top management on any significant occurrences.

Trend-Impact Analysis. Developed by the Futures Group, trend impact analysis tailors statistical forecasts with judgmental adjustments. For example, factors which have continuous impacts, such as population growth, are modeled with quantitative methods. However, factors that impact the structure of the scenario in a sudden fashion are identified by a judgmental method (such as Delphi, expert opinion, or scenario development). The judgmental factors are then employed to adjust the extrapolated

statistical forecast (Bunn and Salo, 1993:294-295). Huss and Honton (1987:23) present eight steps that are used in trend-impact analysis.

1. Select topic and identify key scenario drivers. The two or three drivers selected are divided into alternative states. For instance, one driver may be the GNP (high, medium or low) while the other driver may be the regulatory environment (tight or loose). All of the alternative states are then entered into a matrix. Using this example, six alternative scenarios can be created.
2. Create a scenario space. Create a scenario space by selecting a subset of the scenarios from the matrix. For example, two of the scenarios may be 1) high GNP/tight regulatory environment and 2) low GNP/loose regulatory environment. Each of the six scenarios are then processed through steps 3-7.
3. Identify important trends and collect time series data. Collect historical data.
4. Prepare a naive extrapolation. Use standard time series techniques.
5. Establish a list of impacting events. Using methods such as the Delphi or nominal group technique, or conducting literature reviews, a list of impacting events is developed. These include such issues as political, social, economic and technological events.
6. Establish probabilities of events occurring over time including years to first impact, years to maximum impact, level of maximum impact, years to steady state impact and level of steady state impact. Probabilities are estimated using various statistical techniques.
7. Modify the extrapolation. Combine impact and event probabilities to adjust the extrapolation of the impacting trends.
8. Write narratives describing the scenarios. Narrative are written based on the trend impact analysis.

The advantages of trend-impact analysis are that it combines traditional forecasting approaches with qualitative factors, and it forces the user to identify impacting factors, their probability and importance. A disadvantage is that it does not consider the impacts that events may have on each other. It is also only designed for (and best suited for) the evaluation of one key decision or forecast variable which is quantitative and which has available historical data information.

Cross-impact analysis is a methodology used to study the interdependence of key drivers such as social, economic, political and technological variables. The interactions

are quantified by assigning conditional probabilities that reflect how one event occurring influences the probabilities of other events. Less quantitative methods of analyzing interdependencies between variables are being developed, such as the visual representation techniques of belief nets and influence diagrams. However, there are still a number of inconsistencies in these approaches to understand interdependence (Bunn and Salo, 1993:297).

Cross-impact provides a method of integrating intuitive forecasts by accounting for the interaction between events. Cross-impact analysis models are used by practitioners today for scenario analysis. Two of the most popular methods are INTERAX and BASICS (Huss and Honton, 1987:24).

INTERAX. The Interactive Cross-Impact Simulation (INTERAX) Model was developed by the Center for Futures Research at the University of Southern California with the support of 12 major US corporations, including General Motors, Pratt and Whitney Aircraft, and Exxon. It is a "man/machine simulation that combines human analysts, stakeholders, and decision makers with a database of possible future changes in conjunction with computer models in an interactive scenario generation process" (Enzer, 1981:469). According to the Center for Futures Research, INTERAX is "a forecasting procedure that uses both analytical models and human analysts to develop a better understanding of alternative future environments" (Huss and Honton, 1987:24).

INTERAX is a computer-based, interactive scenario generator that uses a database of "future events and trend projections, and information describing their causal linkages, to simulate alternative futures" (Enzer, 1981:479). The database contains information on a

broad range of corporate strategic issues, and can be supplemented with issue-specific events and trends for a specific scenario analysis project.

INTERAX runs Monte Carlo (random) simulations based on interactions between three modules: the cross-impact model, the corporate model, and interactor groups. The cross-impact model uses a random number simulation to determine outcomes based on the probabilities and interactions found in the database. The corporate model details the internal workings of the organization to aid in the evaluation of future performance, such as through projected balance sheets and income statements. The interactor groups are people that evaluate the progress of the simulation and make adjustments in the model to better simulate reality. The program pauses after projecting a scenario a year into the future so that the interactors have an opportunity to interact with the simulation and try out different corporate policies.

The INTERAX system prints out results at the end of the process, including the trend projections, the changes that occurred during the simulation and their timing, and a narrative describing the simulated future. The interactors can conduct another simulation run on the INTERAX program. Due to the probabilistic nature of simulation, this added run will usually produce different results. This analysis can be repeated many times by different groups of people within the same organization. This process will give the interactors a better appreciation of the alternative futures the organization may encounter, as well as help develop more resilient plans. The bottom-line of the scenario analysis process is to generate more robust strategies that will respond effectively to a number of different possible futures (Enzer, 1981:482).

Besides running in an interactive mode, INTERAX can perform other functions as well. The system can perform sensitivity analysis on the impact of events occurring or not occurring, policy changes, or combinations of all three. In conjunction with these sensitivity analyses, INTERAX can conduct trend-impact analysis to measure the variability of trend projections and their correlation's. Finally, INTERAX can generate a particular scenario through the setting of all event occurrences and their timing.

The INTERAX approach comprises eight steps:

1. Define the issue and time period of analysis. Define the issues along with the geographical scope and time period.
2. Identify key indicators. Key indicators are attributes of the system that can be measured at any time e.g. the budget deficit or U.S. oil consumption.
3. Project key indicators. Each model is independently forecasted using econometric and other time series techniques.
4. Identify impacting events using the database and other research. Here, the developers conduct interviews, review literature and conduct Delphi sessions to identify events that would significantly affect the indicators.
5. Develop event probability distributions. The time periods are divided into smaller periods and a cumulative probability is derived that estimates the chances of those smaller periods occurring before the expiration of the entire time period.
6. Estimate impacts of events on trends.
7. Complete cross-impact analysis, determining what effect the events will have on each other.
8. Run the simulation model. (Huss and Honton, 1987:24)

Several problems arise in the creation of a database. If the inputs to the database are forecasts extracted from current literature and commercially available databases, the forecasts may have been made at different times and under different assumptions. They may contradict each other, or be incompatible. A conglomeration of independent forecasts does not provide information about relationships between various events, and

knowledge of linkages and cross-impacts between variables is essential for conducting scenario analysis.

To avoid these limitations of gathering forecasts from various secondary sources, the developers of the INTERAX created a new database covering 40 different areas of the global environment, such as economic variables, energy, the food supply, and religion. A two-round Delphi inquiry was used to collect opinions from 74 experts around the world. 400 future changes were identified and evaluated in terms of probability and timing, causes, and consequences. The future developments within each topic area were divided into three categories: (1) changes expected to occur within the next two decades, (2) changes less likely to occur in the next two decades that would have a significant impact if they did occur (called "wild cards"), and (3) prior conditions which could encourage or inhibit the change from occurring (Enzer, 1981:470). The Delphi study was continued on an ongoing basis to track information on 100 events and 50 trends.

The are several advantages to using INTERAX. First, it combines the strengths of trend-impact analysis and cross-impact analysis. It can also be modified by the users at the end of each time period. Once in place, it is easy to update the models and compare actual values with projections. Finally, INTERAX improves the skills of the strategic analyst.

There are also disadvantages to using INTERAX. The selection of the events are based on random user-entered probabilities. There is no consideration of whether a combination of these events are even plausible. Also, there is little indication of which scenario is more likely to occur. To counter this it is advised to run several simulations

and conduct statistical analysis of results. Finally, in addition to having a high start-up cost, INTERAX is difficult for people to learn that do not have experience with interactive design processes.

BASICS. The Battelle Scenario Inputs to Corporate Strategies (BASICS) approach began in 1977 as a joint project between the Geneva, Frankfurt, Columbus, and Northwest Laboratories of Battelle Memorial Institute. The BASICS approach differs from the INTERAX approach in that it does not use a random Monte Carlo simulation, and it does not require an independent forecast of variables. It is a probabilistic forecasting tool which uses predefined probabilities and interaction as inputs for a simulation model. The BASICS methodology is composed of seven steps:

1. Define and structure the topic, including unit of measure, time frame, and geographic scope.
2. Identify and structure the areas of influence (using idea generation, Delphi, literature reviews, and interviews of experts). Areas of influence can be social, economic, political technological, resource-related, or regulatory. The areas of influence are then reduced to a reasonable number (15-25) and refined into descriptors.
3. Define descriptors. Descriptors are variables, events, or trends that describe the topic. Write essays for each descriptor that are 2-10 pages long to define the descriptor and explain its importance. Essay will include background information, recapitulate projected outcomes, list references, define alternative states and their probabilities of occurring, and identify cross-impacts with other descriptors. Using expert panels or a Delphi-type approach, assign initial probabilities of occurrence to each state (level) that a descriptor could assume.
4. Complete the cross-impact matrix. A rating is given that establishes a relationship between variables on a scale from -3 (negative relationship) to +3 (positive correlation). The information is entered into the computer and the BASICS simulation model is run, starting with a defined set of starting points. The model systematically selects the sets of descriptor states that are most likely to occur together. The output of the simulation is a table that summarizes the results of the simulation run, detailing which scenarios occurred and how often they occurred.
5. Select scenarios for further study. Scenarios that differ only slightly can be combined. Usually two to four scenarios are selected for presentation to

management (those that are most likely, most consistent, or having the greatest impact). Detailed narratives are constructed that describe the scenario and its progression over time, as well as the impact on the organization.

6. Introduce low probability but high-impact events and conduct other sensitivity analyses. Examples include the assassination of a world leader or an oil embargo. These events affect the other descriptors but are not affected by themselves.
7. Sessions are held with managers to discuss the implications of the scenarios (one scenario at a time). A structured meeting is conducted to develop and rank implications of the particular scenario on the company. Each major implication is then compared against current product areas, and the robustness of company plans and policies in light of future potentialities can then be discussed. (Huss and Honton, 1987:26)

Huss and Honton (1987:28) state there are three major advantages of BASICS. It does not depend on the Monte Carlo simulation; therefore, the results generate a distribution of scenarios based on their relative likelihood of occurring. BASICS offers flexibility and a broader set of outcomes through the interaction of ranges of descriptors and uncertain events. Finally, BASICS runs on a personal computer, enabling rapid input and editing of data and on-line sensitivity analyses.

The major disadvantage to BASICS is that its computer algorithm generates "state scenarios." State scenarios describe the business environment as it would occur at the end of the forecast horizon. "The user must be creative in incorporating time dynamics by (1) explicitly including alternative paths in the state definitions, (2) assuming a straight line extrapolation from the current time period through the forecast horizon, (3) using the descriptor essay to implicitly develop projections from the current time period through the forecast horizon, (4) analyzing which states are set to occur early and which set to occur late as part of the algorithm (assumes that highly probable events occur early in time),

and/or (5) preparing separate matrices for each time frame and using the results of one as inputs to the next time period" (Huss and Honton, 1987:29).

Two variations of the cross-impact analysis method are the approaches by Meadows, et. al. (1972:31) and Mesavoric and Pestel (1974). The computer model used by Meadows, et. al. in 1972 is based on a method called System Dynamics which views the structure of a system as circular, interlocking cause-and-effect relationships and feedback loops. Increasing the value of one variable in the loop has a ripple effect through the model, affecting the other loops, and eventually having an impact on the original variable changed. Meadows, et. al. (1972) used this type of model to generate scenarios of global futures.

Mesavoric and Pestel (1974) used a highly complex world model that stored over 100,000 relationships in the computer. The world was subdivided into 10 regions and corresponding physical, ecological, technological, economic, and social characteristics. The model was used to create scenarios for the future of mankind.

Applications

The current literature on scenario analysis provides several examples of organizations that use the method. Some corporate applications are listed in Table 3-7. A few examples are given, including Compaq, Atlantic Richfield, SEER, and the Georgia Power Company.

Table 3-7. Corporate Applications (Adapted from Millett, 1983:67)

Company	Topic	Uses
General Electric (1971)	Four Alternative World/US Scenarios, 1971-1980	Identify changing customer behavior and emerging business opportunities
Shell Oil (1978)	Tomorrow's Energy: 1990 & Beyond	Assess US energy demands and supply (market)
Shell International (1970s)	International Oil, 2000	Assess worldwide business market for oil (risks and opportunities)
Rockwell International (1984)	Global Environment for US Security to 2002	Evaluate future missions and aircraft requirements for USAF (new product development)
Goodyear Aerospace (1984, 1985)	The International Environment and US Defense Spending to 1996	Identify future business viability of technological R&D
Southern California Edison (1986, 1987)	US and California electricity requirements to 2000	Generation and transmission needs for electric utility service area in Southern California
BellSouth (1985-1987)	US/Southeastern telecommunications to 2000	Telecommunication conditions and opportunities
LA Department of Water and Power (1988)	Los Angeles 2007	Electricity demand and customer characteristics for resource planning
McDonnell-Douglas (1987)	Inter-nation air travel, 2000	Risks & opportunities for commercial air transportation
Atlantic Richfield (1985)	World Scenarios 1985-2005	Forecast oil prices
Georgia Power Company (1987)	Scenarios of Economic Growth to 2010	Budget Energy and Peak Load Forecast, develop contingency plans

Compaq. Jain (1986:31) gives an example of how scenarios may be developed for a computer company such as Compaq. Using Jain's steps outlined in the "Qualitative Methods" section of this chapter, four scenarios were constructed depicting the future possibilities facing Compaq if they built a new 386 Deskpro computer:

> Scenario 1. IBM could come out with a similar product in the near future. Based on IBM's good reputation, many people may wait until they come out with the new computer.

Scenario 2. IBM may come out with a similar computer, but not for another two years. Most customers need the computers immediately; therefore, IBM will lose these customers to Compaq.

Scenario 3. IBM may come out with a much more superior computer in three years. This computer will have more memory, storage space and software compatibility. After three years, IBM may capture back a large amount of its lost customers.

Scenario 4. IBM and Digital Equipment Corporation may produce a better computer within the next two years. With the intensifying competition, Compaq may lose many customers to these two competitors.

Using these four scenarios, a company such as Compaq could build a strategy or a set of strategies based on the possible future outcomes.

Atlantic Richfield Company. Jones (1985:20-22) reports the Atlantic Richfield Company used a two step process to apply the multiple scenario approach to its strategic planning process: *scenario development and forecast preparation.* Using the substeps discussed in the "Qualitative Methods" section of this chapter, four scenarios were generated. The four scenarios, for the period 1985 to 2005, show the possible futures of the economy and how they may affect global oil prices. The first two scenarios describe a world in which consensus dominates conflict. Here, the world is evolving in a smooth manner with few surprises. The two scenarios that depict these situations are called "muddling through" and "economic renaissance." The next two scenarios describe a world that is in constant turmoil. There are violent cyclical trends, along with social and political disunity. These two scenarios are called "reinflation and stagnation rebirth." After the scenarios were generated, Atlantic Richfield developed forecasts for each

scenario using econometric models, with the values of key variables in that scenario used as inputs. These forecasts were then incorporated into the strategic planning process.

Scenario Exploration, Elaboration, and Review (SEER). Through the use of scenarios, Kendall, et al. (1992:123) examined how the role of the information systems analyst might change as the twenty-first century approaches. Prior to developing the scenarios, assumptions were made regarding the variables that impact the analysts' role. The assumptions were that the information system function is going to continue to move toward a strategic role, technological advances will continue, and current trends in the methods of systems development will continue to grow.

To conduct the research, a team of four systems analysts developed a methodology called SEER (Scenario Exploration, Elaboration, and Review). It is a program that can be characterized as the opposite of the Delphi method. The Delphi method uses qualified experts to solve a problem: each expert presents an idea and it is shared anonymously. After assimilation by each member, the query is again submitted to the experts. This process is continued until a consensus is reached and all agree. With SEER, the process begins with the setting (solution) being presented, e.g., the role of the analyst in the twenty-first century. The problems that are encountered in obtaining that role are then developed. In contrast to the Delphi method, SEER participants are not anonymous. Their views are disclosed to one another during the process in an oral (instead of written) response.

In this study, one scenario was developed independently by each participant of the team. The scenarios are based on four problems that need to be addressed in the future.

The scenarios are: overburdening the analyst, overbuilding the system, the myth of control, and the inflexible organization. Each member then independently analyzed his or her scenario and developed variables that might cause the problems pertaining to his particular scenario. By allowing each member to address a single scenario, the team was able to point out how each member's ideas were different from one another. The four scenarios created were then used to examine the possible futures of the systems analyst.

Georgia Power Company. Georgia Power Company (GPC) is one the largest electric utility companies in the country. According to Goldfarb and Huss (1988:78), GPC hired the Battelle Columbus Division in 1986 to assist them in developing a set of scenarios about the future. GPC was not satisfied with the inadequacies of traditional forecasting methods, so in 1987 it employed scenario analysis to develop alternative assumptions about the future environment in which it would compete. These assumptions would form the basis of GPC's 1987 Budget Energy and Peak Load Forecast. The company's goal was to develop several scenarios which would include environmental inputs such as economic, technological, social and political impacts. The scenarios would then be integrated into the existing forecasting model.

During this time, GPC was experiencing various uncertainties about its future growth. A decrease in annual growth had occurred of two to three percent from 1974 to 1986. The legislature was considering modifications to federal government regulations concerning acid rain and nuclear generation. Competition from natural gas companies was on the increase due to the deregulation of prices. Small power-producing companies were

also invading the territories once held by GPC. Additionally, electrotechnology was impacting the company's load capacity (Goldfarb and Huss, 1988:78).

To develop the scenarios, the Battelle Columbus Division used a scenario building process called BASICS (Battelle Scenario Inputs to Corporate Strategies). This method was chosen because it integrated qualitative information with quantitative methods. By integrating the two types of information, GPC was confident that consistent and detailed scenarios would be developed. The BASICS approach consisted of seven steps.

The first step was to "define and structure the topic including unit of measure, time frame and geographic scope." GPC's topic was to forecast the "demand for central station generated electricity in GWh in the Georgia Power service territory to the year 1995."

The next step was to "identify and structure the areas of influence on the topic." GPC assembled five panels of experts from within and external to the company. These panels identified the five most important influencing factors: economics and demographics, raw fuels, technology, political/regulatory, and national electricity prices/GPC rates.

Thirdly, GPC's task was to "define descriptors, write essays for each descriptor, and assign initial probabilities of occurrence." Using the Nominal Group Technique, the panels and other members of the company developed and ranked a number of "descriptors." These descriptors are trends and events used to produce an essay that describes the history and identified alternative futures for each factor.

Fourth, the method dictated to "Complete the cross-impact matrix and run the BASICS program." Using cross-impact analysis, the effects of one descriptor on another was determined. The effects were measured on a scale from -3 to +3. The sign shows the direction of the relationship, while the numerical value shows its strength. For instance, if industrial electrification increased, how would that affect the chances of a high capital return? It is assumed that this would have a strong positive effect, so this relationship would be represented by a +3. The information obtained from the first three steps were entered into the BASICS program. The program selected the most probable set of descriptors that would occur together, and from them developed numerous scenarios. After combining several of these scenarios, GPC chose to further develop three of them. The three scenarios were termed "high economic growth," "moderate economic growth," and "low economic growth."

Fifthly, GPC was to "select and interpret the crucial scenarios." This step involved writing narratives for each scenario. The narrative included the unfolding of the scenario, the assumptions the scenario was based on and the interactions between the factors. Top management also reviewed each scenario to determine if it describes the environmental views of the organization.

The sixth step was to "introduce low probability, high impact events and sensitivity analysis." To test the effects of interaction between factors, sensitivity analysis was run. None of the assumptions significantly impacted the results.

The final step was to "make forecasts and study implications." The moderate economic growth scenario was used as an input to the 1987 budget. Using several

different models, the scenario was translated into economic, demographic, fuel and electricity price inputs. These inputs were then entered into the Budget 1987 load and energy models (Goldfarb and Huss, 1988:79-82).

From each scenario, a generation expansion plan was created that employed the load and energy forecasts derived. These plans were used as contingency plans in the event of an unlikely occurrence.

Summaries of GPC Scenarios. The following is a brief description of the three scenarios developed using the BASICS program. The scenarios were named according to their descriptor state for U.S. economic growth.

1. Scenario A- High Economic Growth. Between 1987 and the year 2010, the Gross National Product (GNP) will surpass an average growth rate of 3.2 percent. The state of Georgia will exceed this growth rate up to one percent. The U.S. will experience an increase in productivity due to the baby boom generation maturing. Oil prices will not exceed $18 per barrel (1985 dollars) because of the transition from an OPEC controlled oil market to a commodity-based environment. The demand for natural gas will decrease due to the lower cost of oil.

2. Scenario B- Moderate Economic Growth. The GNP will range from 2.7 to 3.2 percent per year with Georgia exceeding this rate. Georgia will experience a decrease in the net migration rate to 32,000 people per year. This is due to the South having an advantage over the North in terms of wage rates and tax costs. Productivity will range from 1.5 to 2.1 percent per year while interest rates remain high and new investments decline. The world surplus of oil will decline slowly, causing the oil prices to rise to around $23 per barrel. Natural gas exploration and development will remain sporadic with the price of natural gas roughly equaling the price of oil.

3. Scenario C-Low Economic Growth. The GNP will not exceed 2.7 percent because of the trade imbalance and national deficit. Georgia will continue to exceed the personal income growth rate by over one percent. As the population ages, the U.S. productivity rate will decrease to 1.5 percent. With OPEC returning to control oil prices and the reduction in oil surplus, oil prices will rise to over $30 per barrel.

> New energy policies will hinder exploration and development ventures. Natural gas will experience erratic demand rates because of the deregulation of prices (Goldfarb and Huss, 1988:82-83).

Conclusion

This chapter integrated the current literature on scenario analysis. It began by giving a basic overview of strategic planning and its subprocess, environmental analysis. Forecasting was reviewed as an introduction to scenario analysis. Several aspects of scenario analysis were discussed, including definitions, uses, classifications, construction methodologies, and corporate applications.

Chapter IV presents a synthesis of the material found in the literature review. Various models of scenario development are compared, and integrated into one overarching model that can be used by Air Force managers and planners. Applications of scenario analysis in the Air Force are also discussed. An instructional implementation guide tailored for the Air Force is found in Appendix B.

IV. A Composite Model and Air Force Applications

In this chapter, a composite model is presented that incorporates the elements found in the different approaches to scenario analysis presented in Chapter III. Appendix A contains tables used to compare the steps of the different methods, and the common elements are categorically grouped and listed in Figure 4-1. The order of the elements in the composite model is discussed, and then illustrated in graphical form. Each component of the composite model is shown graphically and discussed.

Next, the current environment of the United States Air Force is considered as a backdrop for implementation of the scenario analysis methodology. Advantages and disadvantages of using scenario analysis in the Air Force are discussed, as well as appropriate applications and specific methods well-suited to Air Force use. General guidelines for scenario analysis implementation are given, as well as recommendations for future research. Finally, the Scenario Analysis Implementation Guide for the US Air Force in Appendix B is introduced.

A Composite Model of Scenario Analysis

In comparing the many different methods of scenario analysis, certain common elements began to arise. The individual steps of each method were analyzed and contrasted against other methods. The result was that all of the steps fell into similar categories by function, although any particular method did not necessarily address all functions. This analysis gave rise to a composite model that encompasses all of the steps of the various models studied. Figure 4-1 lists the steps grouped into four major

components: establishing a framework, collecting inputs, constructing scenarios, and making application.

Establish a Framework

- Define purpose and objectives.
- Determine scope.
  - Orientation toward time
  - Time frame
  - Level of environment
  - Orientation toward probability

Collect Inputs

- Gather information.
  - Expert opinion/Delphi
  - Current literature
  - Database search
- Define drivers or variables.
  - Probability of occurrence
  - Range
  - Impacts, relationships

Construct Scenarios

- Combine drivers to form scenarios.
  - Matrix/scenario space
  - Simulation
  - Decision tree
  - Intuitive logics
- Narrow down scenarios.
- Write descriptive narratives.

Make Application

- Evaluate strategies in light of scenarios.
- Develop new, robust strategies.
- Devise contingency plans.
- Make forecasts based on scenarios.
- Challenge assumptions and policies.
- Conduct SWOT analysis.
- Conduct sensitivity analysis.

Figure 4-1. Composite Model List of Common Elements

Appendix A, Comparison of Scenario Analysis Method Steps, shows how the steps of different scenario analysis methods compare to the categorical grouping of common elements listed in Figure 4-1. For each method, a short phrase representing each step was listed in the row corresponding to the element of the composite model. The original numbering of steps from each method is included in the table.

The Order of the Composite Model. Common elements were found among the steps of the various methods of scenario analysis; however, to form a composite model, a logical order of the progressive elements was needed. The analysis on the following pages refers to the different approaches to scenario analysis discussed in Chapter III. To review a particular scenario analysis method, the reader can turn to the Table of Contents where each method is listed by author or name of method and page number.

The most obvious task for the first step in the composite model was to establish a framework for the scenario analysis process. However, two methods did not include this step (Becker and trend-impact analysis), perhaps under the assumption that planners would know to define their purposes and determine a scope before proceeding. Foster's model for scenario analysis in a small business listed "stating assumptions" and "determining a time horizon" after "identifying key factors." Similarly, MacNulty made "selecting objectives" her second step, to occur after "developing a database." This order seems inverted, because a businessman might have trouble determining which variables are important before stating assumptions, and the people tasked with creating a database would not know what kind of data they were trying to collect. Therefore, the composite model places the framework component at the beginning of the process.

The second component in the composite model is the process of collecting inputs, which includes two steps: gathering information and defining variables. Gathering information was not specifically listed in the steps of many of the models such as Jain, Becker, Atlantic Richfield, Boroush and Thomas, Schoemaker, and BASICS, although it could certainly be implied as a part of the step of defining drivers or variables. The composite model in Figure 4-2 (on page 4-6) shows a bidirectional arrow between the two steps of this component to illustrate how the two steps are interdependent and work in unison. Only Jain's method did not include either of the substeps of the input collection component, which may indicate that his method shows in more general terms how scenario analysis works, rather than giving practical instruction on how to conduct it.

The third component of the composite model involves constructing the scenarios through a three-step process: combining the drivers to form scenarios, narrowing the number of scenarios, and writing descriptive narratives. The methods differ on the presentation of these steps. Some list only one of the steps, some two, and some all three. Some of the methods did not give specific instructions for constructing the scenarios (Jain, Foster, intuitive logics, Atlantic Richfield), while others gave detailed instruction and even some examples (Becker, MacNulty, Boroush and Thomas, Schoemaker, trend-impact analysis, INTERAX, and BASICS). A few models recommended limiting the number of scenarios before creating them (Becker and MacNulty), which would make the process more manageable, but perhaps at the expense of creativity and thoroughness. For that reason, the composite model lists forming the scenarios before narrowing them down in number.

The final component in the composite model is making application using six possible steps. Some of the models did not list any steps relating to this component (Jain, Foster, and INTERAX). Again, perhaps the writers describing the methods left them out because the outputs of the scenario analysis process could feed into an organization's strategic planning structure, which would utilize the results in practical ways. Some of the methods included helpful instructions of ways to use the scenarios generated in the previous component (intuitive logics, MacNulty, Atlantic Richfield, Boroush and Thomas, and Schoemaker). These applications could be used in conjunction with any scenario analysis method used, so they are all included in the composite model.

The Composite Model Illustrated. Figure 4-2 presents the composite model in a systems-theory type format, with arrows indicating inputs and outputs of the processes. Next, the model is dissected so that components of the model can be discussed in greater detail.

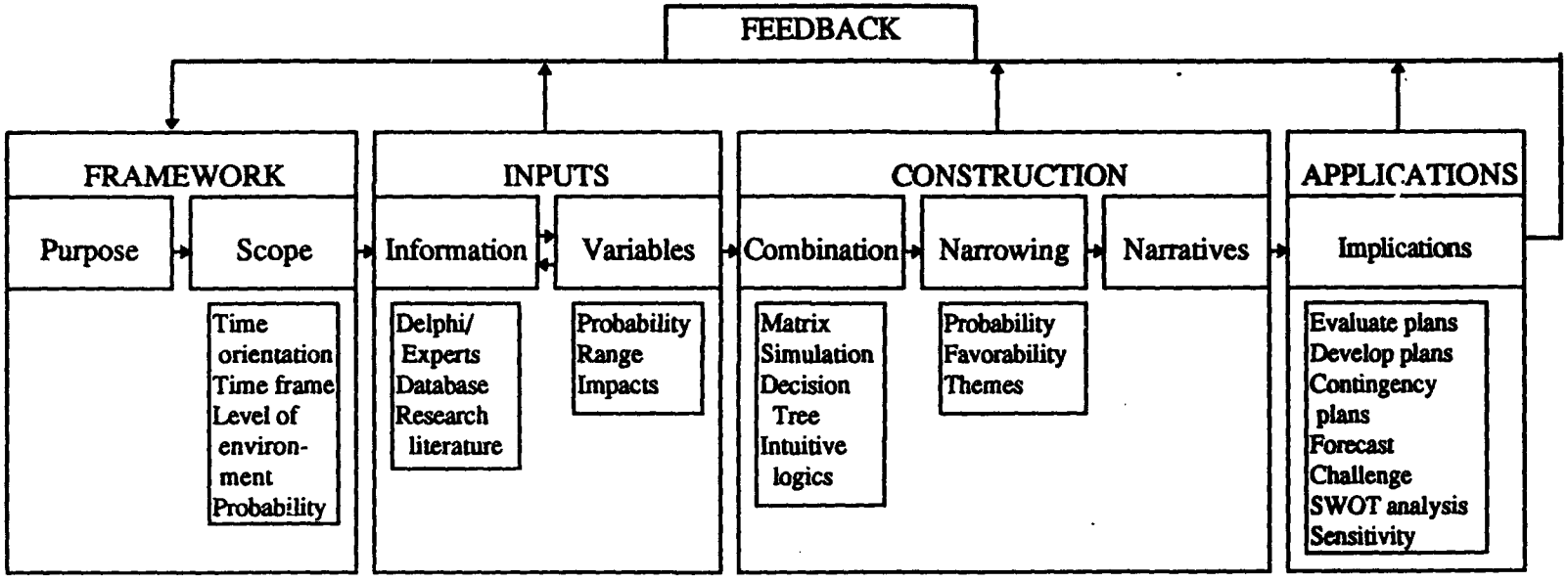

Figure 4-2. Composite Model Illustrated

Figure 4-3 shows the logical order of performance for each of the main groupings of the composite model from a systems-theory perspective: the framework, inputs, construction, and application components. The feedback loop illustrates how the process can be a continuing effort, and how an organization can use the results of scenario analysis to challenge original assumptions. The following illustrations show each component in more detail.

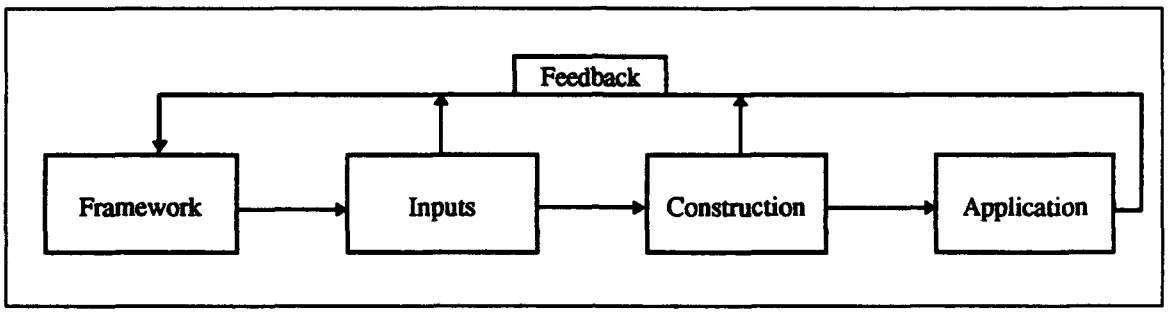

Figure 4-3. Composite Model Main Components

Figure 4-4 shows the first step as definition of the purpose and objectives for the scenario analysis. This step provides direction for the rest of the process, while the next step of determining scope creates boundaries. Determining an orientation to time refers to decisions about a forward versus backward approach and a snapshot versus progressive approach. A forward approach starts at the current time and follows the progression of variables into the future. A backward time approach starts with a description of the future environment and looks for possible trends that created it. A snapshot view describes the future environment, while a progressive view describes the future and the intervening events that created it. The time frame should also be decided. For example, will the scenario span two, five or twenty years? The level of environment is selected to limit the scope of which variables are considered in constructing scenarios and how specific the scenarios will be. The orientation toward probability refers to the use of stable trend

patterns and/or discontinuous "surprises." Together, the elements of the framework component lay the foundation for the rest of the scenario analysis.

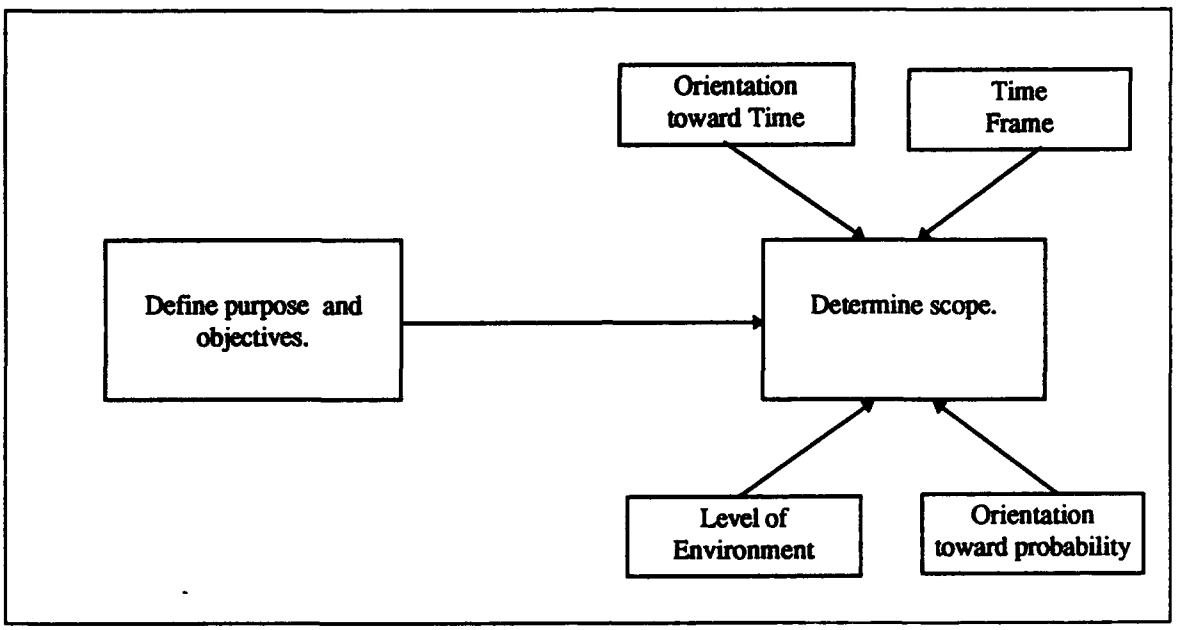

Figure 4-4. Establishing a Framework

Once the framework has been established, the process of collecting inputs for the scenario analysis process begins, as shown in Figure 4-5. First, information must be gathered. There are several sources of information that would be useful to scenario analysis, starting with the knowledge of experts in the organization. The knowledge of experts both internal and external to the organization can be harnessed through the use of the Delphi method, nominal group technique, brainstorming, or various other qualitative methods. Also, the organization may be able to tap a database or historical files for data relevant to the scenario analysis process. Several commercial databases are also available, for a fee. The local library and online reference sources can also provide information in a review of current literature.

After exploratory information is gathered, the next step is to define drivers or variables that will form the basis for the scenarios. The range of variables to consider will have already been limited in the previous step of determining an appropriate level of environment, but in this step variables are actually chosen. Depending on the method of scenario analysis chosen, certain elements of information must be collected for each variable. The more qualitative methods may use descriptions of each variable, detailing various impacts that can cause the variable to be high or low. Some of the more quantitative methods may require estimates of the probability of occurrence for each variable, as well as a numerical correlation between variables. Some methods require an estimate of a range in which the variable could change, such as GNP decreasing by three percent or increasing up to five percent. The bidirectional arrow between the steps of gathering information and defining variables indicates that they may happen concurrently. Although broad information must first be gathered to determine which variables should be considered, more precise information is needed once the variables are defined.

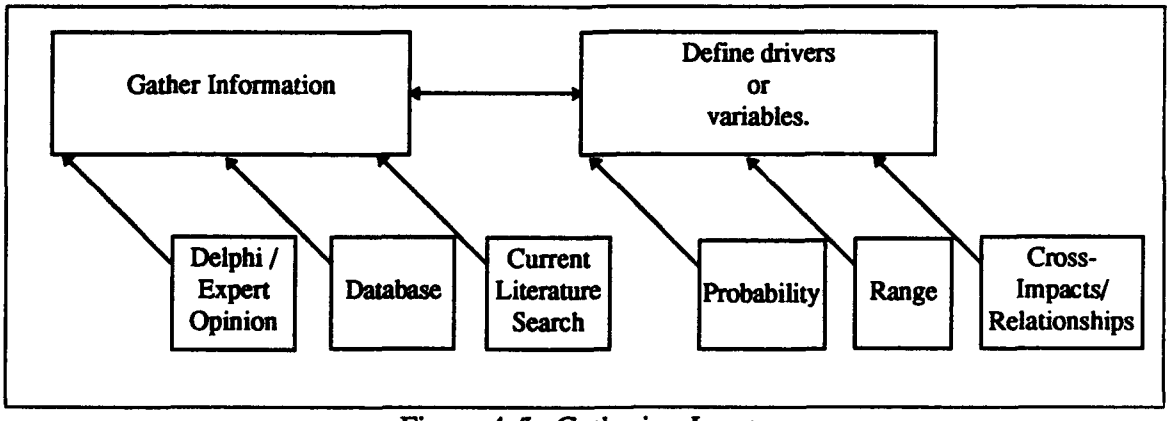

Figure 4-5. Gathering Inputs

The next component entails the actual construction of the scenarios, as seen in Figure 4-6. The first step is the combination of variables at different levels to form

scenarios. Combining the drivers can be accomplished through the use of intuitive logics, matrices, simulation programs, decision trees, or other quantitative or qualitative methods.

Once the scenarios are developed, the next step is to narrow them to a manageable few (typically two to four). Different criteria can be used to narrow them, such as level of probability (most likely to least likely), favorability (optimistic and pessimistic), themes, or a combination of these. A descriptive narrative is then written for each scenario.

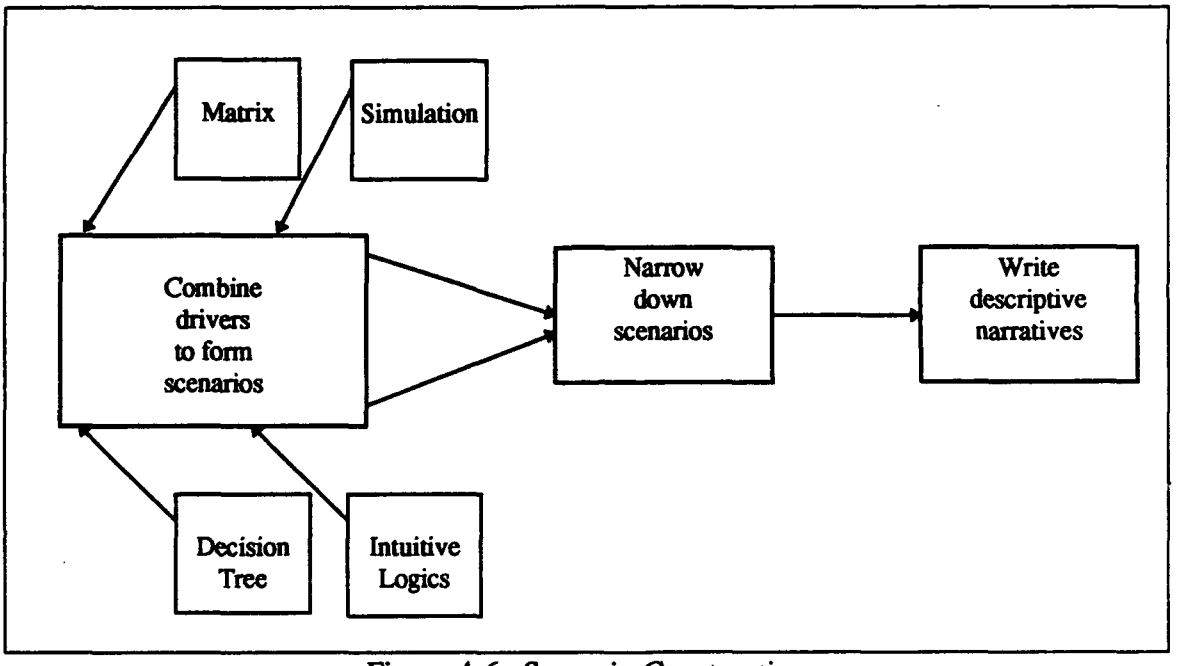

Figure 4-6. Scenario Construction

To be fully effective, no scenario analysis effort should end without some analysis and application of the results. All of the different processes depicted in Figure 4-7 are not necessarily prescribed for each method of scenario analysis, but as many as possible should be performed. Evaluating strategies may consist of reexamining the current organizational strategies in light of the scenarios developed, while developing strategies may consist of devising new strategies that will perform well under the conditions of the scenarios generated. Although an organization may want to build a detailed plan around the most

likely scenario, contingency plans can be written and held in case one of the less likely scenarios begins to unfold. Many models, whether using quantitative or qualitative methods to construct the scenarios, use a quantitative method to forecast the level of key variables, given the conditions in each scenario. Some even use the results of each scenario as inputs to complex econometric models.

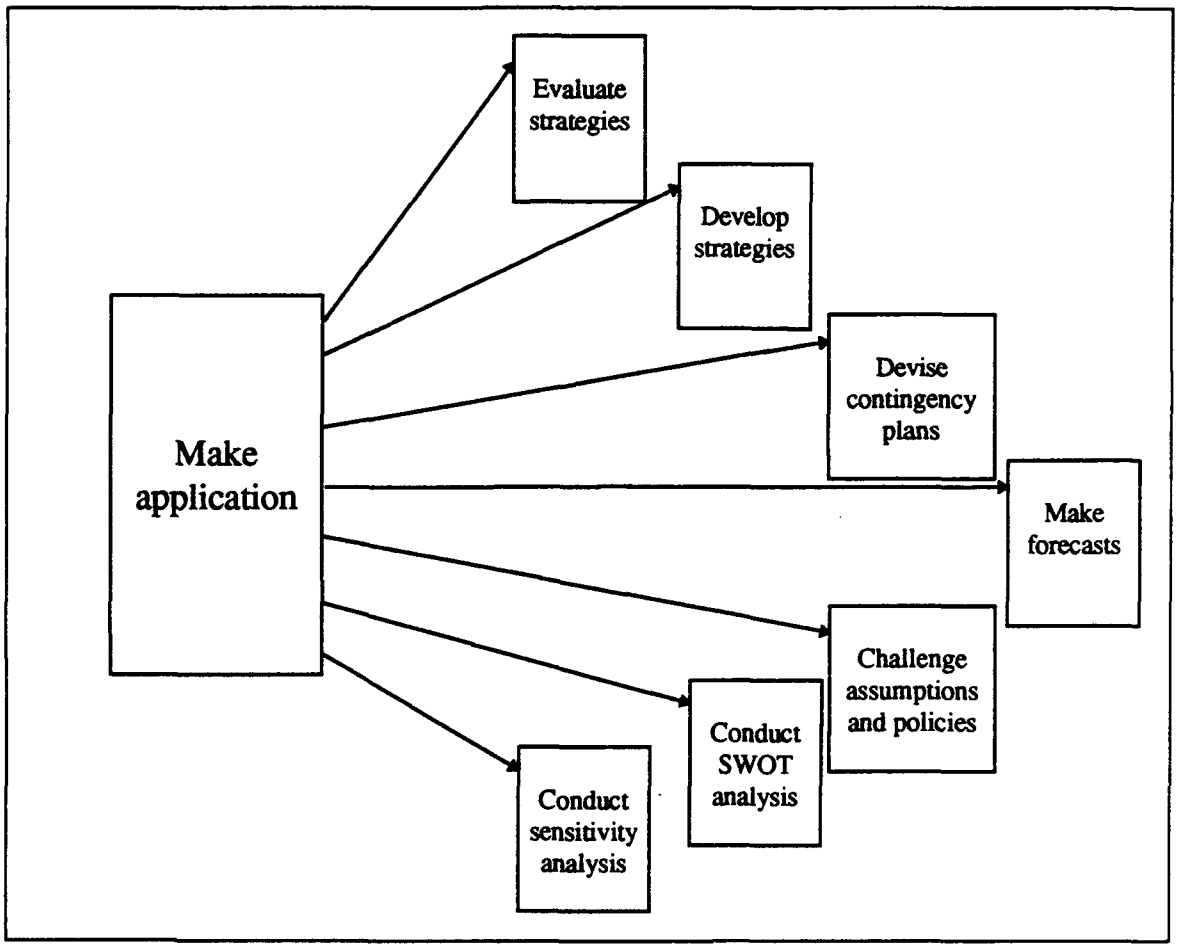

Figure 4-7. Investigation of Implications

Although not specifically recommended in each model, every scenario analysis effort should challenge the assumptions, policies, and world-view of the organization and its members. Some models (such as intuitive logics) instruct that analysis should be conducted to determine the organization's strengths, weaknesses, opportunities, and

threats (SWOT) relative to each scenario. Some scenario analysis methods prescribe sensitivity analysis to determine how a scenario, a variable, or a plan will withstand variations in predicted levels. Some models recommend that the scenario analysis team work through the steps again in an iterative fashion. The implications of the results prescribe what action should be taken next.

Scenario Analysis in the Air Force

The external environment of today's United States Air Force could be described as dynamic, turbulent, and unstable. With the end of the Cold War, the primary military threat to the United States dissolved, leaving Air Force strategists to question "Who is the real enemy?" Several countries scattered around the globe offer potential threats to American interests (e.g., North Korea, Iraq, Haiti). The US role in humanitarian efforts and United Nations peacekeeping operations (e.g., Somalia, Bosnia-Herzegovina, Rwanda) and in international cooperative projects (e.g., anti-drug, anti-pollution, and anti-terrorism activities) have expanded greatly.

Additionally, the financial environment of the Air Force is in a state of flux. Due to the growing national debt, budgetary constraints, and the end of the Cold War, funding to the military has been cut drastically. "Doing less with less" and personnel downsizing are current realities for the Air Force population.

Strategic planners at the highest levels of the Air Force need sophisticated tools for planning for the future. Traditional forecasting methods project the future based primarily on observations from the past, but in this state of turbulence, the future may not resemble the past at all.

The Air Force needs a technique that facilitates forecasting several years into the future and foreseeing the different possible future environments that could exist. The Air Force needs a method of incorporating quantitative figures, interrelationships, and qualitative factors to develop more accurate predictions. Air Force planners and leaders need to understand that the future could turn out very differently from how they imagine it within their personal world-view, and that plans and policies need to be implemented that are robust enough to be effective in many of the alternate possible futures that could occur. Scenario analysis is an excellent tool to accomplish these tasks.

Schoemaker (1993:199) states that industries with a great amount of uncertainty, highly specific assets, and long lead times are the most prevalent and successful users of scenario analysis. For instance, in the petroleum industry, the price of oil fluctuated between $9 and $40 per barrel in the 1980s, capital investments were high and were industry-specific, and the lead times to get a new plant on-line took up to ten years. Malaska (1985:341) found that 73 percent of petroleum and related industries and 64 percent of the transport equipment industry use multiple scenario analysis.

Conditions the Air Force currently faces match Schoemaker's three-part test for using scenario analysis. The military environment is unstable not only because of the dynamic international scene, but also because of the economic factors contributing to its downsizing. Furthermore, Air Force assets such as weapons are so specific that they have little use other than for the purpose of waging war. The leadtimes on many weapon systems can be very long. The acquisition time for these assets is frequently 15 years

(Snoderly and Acker, 1981:3). Scenario analysis is an especially effective method to use under these conditions of instability, high commitment, and long time horizon.

Linneman and Klein (1983:95) surveyed Fortune 1000 companies and found that 51 percent of them claimed to use scenario analysis. The USAF could follow the example of companies such as General Motors, Pratt and Whitney, Atlantic Richfield, the Georgia Power Company, and Shell Oil, and reap many benefits.

Advantages of Scenario Analysis in the Air Force. Implementation of scenario analysis in the Air Force offers many advantages. Linneman and Klein (1985:66) report that multiple scenarios give management an idea of the degree of uncertainty in the future environment. Scenario analysis could keep Air Force leaders, managers, and planners from limiting their perspectives to a single view of the future environment, encouraging them to develop contingency plans and to perform risk analysis on every strategy. Scenario analysis can also help change Air Force leaders' and planners' personal mental maps or "microcosms" to more closely match "the fundamental of the real world" or "macrocosm" (Wack, 1985:84).

Scenarios can "help decision makers develop their own feel for the nature of the system, the forces at work within it, the uncertainties that underlie the alternative scenarios, and the concepts useful for interpreting key data" (Wack, 1985:140). Scenarios give insights on the dynamics of the organization, and could help strategic planners focus on which trends and indications should be monitored.

Scenarios integrate not only quantitative inputs, but also qualitative inputs such as regulatory issues and world politics into the forecasting process (Linneman and Klein, 1985:66). Scenarios are flexible enough to allow the incorporation of

techniques such as econometric modeling, trend analysis and Delphi can be used to develop a scenario (Linneman and Klein, 1985:66). Traditional forecasting methods could lead Air Force planners into falsely assuming that the future will occur in accordance with a forecast based on historical trends that no longer apply.

By testing the effects of alternative events, scenarios promote sensitivity analysis. For instance, they can be used to test the effect of low probability, high impact events such as the assassination of a world leader or an increase in terrorist activity. Many scenario methods allow these events to be depicted using computer models, while other methods depend on the knowledge of the development team (Huss 1988:381). Scenarios could also force an Air Force organization to pay closer attention to pessimistic scenarios and prepare more robust strategies (Becker, 1983:96).

Scenarios encourage communication between organizational departments by forcing them to interact on various issues. Though the departments may not agree on a particular scenario, they do provide a basis upon which planners and management can evaluate the key decisions (Huss 1988:381). By using group processes such as the Delphi method and nominal group technique, scenarios build team spirit and consensus. These group processes can increase organizational communication, emphasize the understanding that shared concerns are to be achieved, and give rise to creative ideas (Huss 1988:381).

Disadvantages of Scenario Analysis in the Air Force. Schoemaker (1993:209) identified three primary drawbacks to using scenario analysis, and all of these could have an impact on the Air Force. First, scenario analysis can have a relatively steep learning

curve, especially if few people in the Air Force have experience in the methods. Additionally, use of multiple scenarios and the different worldview they espouse could create organizational culture shock in an Air Force accustomed to purely quantitative, single-point forecasts. Thirdly, the new challenges of moving from multiple scenarios to a single strategy, budget or plan could lessen the impact of the scenario analysis results.

Potential Applications of Scenario Analysis in the Air Force. Within the Air Force, there are numerous issues to which scenario analysis can be applied. Perhaps most importantly, scenarios can give commanders at all levels an insight into the possible contingencies their units may face. For example, during the Gulf War, scenarios could have been used to determine the number of allied casualties if the Iraqis had launched a full-scale attack. At the wing level, scenarios could be employed to show the effects of a 100 percent flying commitment. With the high level of turnover in the Air Force, scenario analysis could also serve as a tool to retain continuity in assumptions, perspectives, policies, and strategies.

Scenario analysis can be used from the Air Staff level down to the squadron level. Potential Air Force applications of scenario analysis could include:

1. War gaming with each of the military services involved
2. Effects of a decreased budget on Air Force readiness
3. Effects of war on supplies, personnel and communications
4. Consequences of base closures on mission capabilities
5. Effects of base closures on surrounding communities
6. Problems to be faced with homosexual service members
7. Effects of a strike by aerospace companies
8. Possible terrorist targets and plans
9. Aircraft maintenance planning for increased flying hours
10. Supply problems faced by budget cuts
11. Revision of evaluation system
12. Effects of civilian layoffs

Of the various methods analyzed in this thesis, some of them seem better suited for Air Force use: intuitive logics, Boroush and Thomas, Schoemaker, trend-impact analysis, INTERAX, and BASICS. Selecting a method and determining an approach are discussed in detail in Appendix B, which contains a step-by-step guide for implementing scenario analysis in the Air Force.

Implementing Scenario Analysis in the US Air Force. The recommended approach to implement scenario analysis in the Air Force is for the analyst to first become familiar with the method by reading chapter III, the Integrated Literature Review on Scenario Analysis. The next step is to understand the composite model illustrated in Figure 4-2 (page 4-6). Then, the analyst should proceed to work through the Scenario Analysis Implementation Guide for the US Air Force in Appendix B. The guide provides step-by-step instructions for selecting an appropriate level of environment, choosing a methodology, and determining an approach. It also includes guidelines for effective implementation and for gaining acceptance and credibility for the method. The guide is meant to be only the starting point for using scenario analysis. The level of effort required to complete the analysis is dependent on the scope set by the analysts.

In an effort to keep the guide at a manageable size, key concepts and techniques are mentioned only briefly, with the understanding that the analyst will refer to chapter III if more explanation is needed. The bibliography is also a useful tool for additional research. In short, the guide is not designed to be used separately from the rest of the thesis. One drawback to using scenario analysis is that the learning curve can be somewhat steep. If one person or a small team can be designated to research the method and become experts in it, the chances of successful scenario analysis will be greatly

improved. The investment in time can be well worth the effort, because Air Force organizations have so much to gain from this sophisticated method.

General Guidelines for Conducting Scenario Analysis

Some general guidelines are offered here that are applicable to any organization implementing scenario analysis. Topics covered range from tips to make the process more profitable to detailed instruction on details that will impact the quality and accuracy of the scenarios.

Get Top Management Involvement. If top management is not involved in the scenario development process, the results will have little effect on decisions made. To be convinced of the plausibility of the scenarios, management must be involved at the beginning of the development stage, as well as at the end of it. This involvement will ensure that the scenarios are consistent with their views and will lessen the difficulty of trying to "sell" them the final product. It will also reduce the amount of surprise should there be any controversial or disappointing scenarios (Linneman, 1985:67).

Select an Appropriate Time Horizon. Linneman and Klein (1985:71-72) report the majority of companies that perform scenario analysis use a five year time horizon. However, they suggest the company set its time horizon according to its reaction time. Reaction time is the time an organization needs to respond to an environmental change. For example, it is unlikely that a major retailer could increase its market position within the next five years. If the company uses a five year planning horizon and managers do not wish to change it, a scenario could a span a multiple of the five years, such as ten, fifteen, or twenty years. This approach would help management identify some of the

opportunities and obstacles that lie ahead. Schnaars (1987:108) presents two determinants for choosing a time frame for scenarios: how far in the future the organization is committing resources, and the length of time over which large changes in the environment can be expected to occur.

Chapman (1976:4) recommends a time frame of between 15 and 50 years. Forecasting for under 15 years should be accomplished using simulation methods, and a scenario spanning 50 years in the future is purely fictional because there are too many variables that could change in that amount of time. "The time period should be short enough so that the technical possibilities are known," but long enough to project beyond certainties in the environment. Shell Oil uses scenarios with 15 year horizons or more, with the content growing more vague for the distant years (Schnaars, 1987:108).

Tailor the Complexity of the Scenarios. If the firm's management is experienced with advanced planning procedures, a complex scenario methodology may be used. Linneman and Klein (1985:69) found that most companies prefer to use simple scenarios because management is uncomfortable with sophisticated methods. In large companies such as the oil industry, many strategic planners avoid the complex scenarios because they tend to "appear highly academic and impractical" to line managers.

Determine a Proactive or Reactive Stance. Drucker (1973:121) reports a company should try to anticipate and mold its future by controlling or altering some of its variables. This proactive stance, especially among larger companies, can be made by influencing legislation and consumer tastes and preferences. The "sequence-of-events" or "longitudinal" scenarios are especially useful here because management can attempt to

control the timing of the events. Here, management can focus on issues that are within their control, instead of events that are not within their control. Chapman discusses scenario construction from a proactive perspective: "the scenario approach emphasizes the degree to which the future is a matter of choice and can be influenced by policy decisions" (Chapman, 1976:2).

Some firms have little control over the external variables within their environment. Most of these companies which are usually smaller in size, will take a reactive role. They may also use sequential scenarios, but only to explain the changes that occur between the starting and ending points (Linneman and Klein, 1985:70).

Narrow the Number of Scenarios. The more scenarios there are, the less the utility for strategic decision making. Too many scenarios can increase the complexity of the decision making process, thus creating confusion. Linneman and Klein (1985:73) report that management has difficulties in dealing with large numbers of scenarios and suggest that firms new to scenario analysis employ no more than two or three. If an organization is conducting an environmental assessment based on probabilities of occurrence, then they should use three scenarios. According to Linneman and Klein, the first scenario should reflect the present situation, and the second and third scenarios should portray the most pessimistic and optimistic outcomes.

Chapman argues that "the minimum number of options is probably three; reducing the exercise to a binary choice seems too polarized and unrealistic." Each scenario may have subsidiary options or branches. The number of options and branches should be restricted so they can be studied and analyzed sufficiently, but there should be enough to

cover a wide range of choices (Chapman, 1976:4). The accuracy of projected data decreases with increasing time into the future. Instead of graphing a single trend line for each scenario, it would be more accurate to represent each line with a shaded region that increases in width over time. Because of the decreasing accuracy of forecasted data over time, it is futile to analyze a large number of closely spaced scenarios. Using a few, widely-spaced scenarios is preferable, although painting a black and white picture of future possibilities should be avoided (Chapman, 1976:9).

Choose a Criterion for Selecting Scenarios. According to Schnaars (1987:108), there are four driving forces or "background themes" behind scenario selection. These forces, including the favorability of the sponsor, the probability of occurrence, the single dominant issue and the themes, give the managers a criterion to help select the best scenarios.

Favorability of the Sponsor. This procedure is based on its favorability to the sponsor and uses an optimistic and pessimistic prediction. These predictions are used as alternatives to what is called a "surprise-free" or a "baseline" scenario. The possible disadvantage to using this technique is that planners may adhere to the surprise-free scenarios instead of the pessimistic alternative scenarios. If this is the case, the objective of scenario analysis is destroyed.

Probability of Occurrence. Scenarios are arrayed according to their probability of occurrence. For example, one scenario may be labeled as "most likely" while another may be labeled as "least likely." Some researchers, such as Zentner (1982:16), state that this method destroys the objectives of scenario analysis because

planners will focus on the most likely scenario. Cross-Impact Analysis assigns probabilities to the scenarios and then rank orders them according to these probabilities. One of the criticisms of this method is that there is no evidence to support the assigned probabilities. Scenarios are possibilities, not probabilities.

Single, Dominant Issue. In many instances, there is a single dominant issue that overrides other factors in producing an outcome, such as the economy or governmental regulation. Dickson, Ryan and Smulyan (1977:9) give three different scenarios of the future usefulness of hydrogen as an energy source. In this case, government funding is the dominant issue.

Themes. In most scenarios there are factors that interact and compete with one another. Developing scenarios to demonstrate this interaction is another driving force. The interaction may involve factors such as technological, economic and environmental concerns. Themes also concentrate on other possible outcomes that may have been overlooked (Schnaars, 1987:109).

Focus on the Critical Issues. There are two important questions that must be answered: what planning questions need to be illuminated, and what variables do we most need to forecast in order to address these concerns? Because an infinite number of variables could be considered, it is critical to focus only on the issues that directly affect the situation. Without this focus, the task of building a scenario will become enormous (Boroush and Thomas, 1992:28-29).

Employ the Collective Wisdom of the Organization. By gathering the ideas of all participants, the firm will gain three benefits. First, it will foster a team-building

atmosphere in which members will become more committed to the process. Second, it will obtain the valuable insights of senior management. Third, the organization will benefit through the process of learning from the scenario planning exercise. Here, learning is used in an institutional context where managers from different departments can share their ideas and experiences (Werner, 1990:56).

Furnish a Means for Choosing a Risk/Return Preference. Because measuring risk for an uncertain future is difficult, the organization must determine the level of risk most comfortable to the organization's leadership. The aim is not only to establish an accurate risk measurement, but to also to give a choice of risks to take that are equal to the organization's political and cultural risk levels. Providing these risk options enables the firm to choose according to its risk aversion level (Werner, 1990:57).

Save the Quantitative Forecasting Analysis for the Latter Part. The early stages of the scenario analysis process should use only qualitative information. Quantitative information is necessary to provide unambiguous assumptions; however, it tends to obscure some of the uncertainties that must be introduced in the initial stages of the scenario. Boroush found that qualitative discussions during the early stages of scenario building give a better understanding of the "discontinuities" and also set a better stage for the use of the forecasting models (Boroush and Thomas, 1992:28-29).

These guidelines are starting points for conducting effective scenario analysis. Experience in scenario analysis, further research on different methods and applications, and the advice of consultants can also greatly add to the usefulness and predictive ability of the multiple scenario analysis approach.

Recommendations for Future Research

The composite model illustrated in Figure 4-2 and the implementation guidebook in Appendix B were designed from secondary research found in the literature. Further research on this topic could include testing the model and guidebook for use in US Air Force applications. Additionally, in-depth case studies of defense-related organizations using scenario analysis could be conducted.

Conclusion

This chapter presented a comparison of scenario analysis method steps in the form of a composite model of the common elements. Applications of scenario analysis in the United States Air Force were discussed, as well as the benefits to be reaped from implementing this method. Finally, some general guidelines for conducting effective scenario analysis were provided, as well as recommendations for further research in this field. Although this is the last chapter of the thesis, the most important part has not yet been presented: the implementation guide. It can be found in Appendix B.

Appendix A. Comparison of Scenario Analysis Method Steps

Table A-1. Comparison of Scenario Analysis Method Steps

Step	Foster (page 3-34)	Jain (page 3-34)	Atlantic Richfield (page 3-35)
Define purpose and objectives		1. Define what is to be forecasted	1. Determine critical decisions to be made.
Determine scope	2. State assumptions/time horizons.	2. Select a timeframe.	
Gather information.	3. Identify sources of information for key factors.		
Define drivers or variables.	1. Identify key factors. 4. Identify interactions.		2. Develop trends of key variables. 3. Select forces for change which impact the trends.
Combine drivers to form scenarios.	5. Develop the scenarios.	3. Establish scenarios.	4. Create scenarios (intuitively).
Narrow down scenarios.		4. Select the most likely scenario.	
Write descriptive narratives.			
Make forecasts.		5. Prepare a forecast based on the most likely scenario.	5. Develop forecast of oil prices for each scenario using econometric model.
Conduct SWOT analysis.			6. Analyze issues, risks, opportunities.
Conduct sensitivity analysis.			
Evaluate/develop strategies.			
Challenge assumptions and policies.			6. Feedback loop.
Devise contingency plans.			

Step	Chapman (page 3-36)	Becker (page 3-36)	Schoemaker (page 3-36)
Define purpose and objectives	1. Determine the purpose of the study.		1. Define issues: decision variables.
Determine scope.	2. Choose a timescale and scene years.		1. Define issues: time frame and scope. 2. Identify major stakeholders.
Gather information.			
Define drivers or variables.		1. Select drivers. 2. Select range of values for drivers.	3. Identify trends that affect variables. 4. Identify key uncertainties.
Combine drivers to form scenarios.	4. State philosophy of each option. 5. Construct snapshot views. 7. Set policy time series.	4. Choose trends/ indicators. 6. Describe possible future conditions.	5. Construct best and worst case scenarios. 9. Assess interactions of variables.
Narrow down scenarios.	3. Decide on the number of branches/options to be discussed.	3. Select specific scenarios to be developed.	6. Assess internal consistency of scenarios. 7. Eliminate inconsistent scenarios and create new ones.
Write descriptive narratives.			
Make forecasts.		5. Prepare projection.	
Conduct SWOT analysis.	9. Conduct additional evaluation.	7. Develop implications for the business.	8. Identify topics that would support learning scenarios.
Conduct sensitivity analysis.	6. Conduct consistency check. 8.Test for robustness.		8. Assess how stakeholders world behave in new scenarios.
Evaluate/develop strategies.	9. Conduct additional evaluation.	8. Develop strategies.	
Challenge assumptions and policies.	9. Conduct additional evaluation.		9. Feedback
Devise contingency plans.			

Step	Boroush & Thomas (page 3-38)	Intuitive Logics (page 3-39)	MacNulty (page 3-42)
Define purpose and objectives	1. Preparation stage: Define the focus	1. Analyze decisions and strategic concerns.	2. Select objectives.
Determine scope.	1. Preparation stage: Define the focus.	1. Analyze decisions and strategic concerns.	
Gather information.		4. Analyze environmental forces.	1. Develop database.
Define drivers or variables.	1. Preparation stage: Chart the driving forces.	2. Identify key decision factors. 3. Identify key environmental factors.	3. Evaluate organizational variables. 4. Evaluate environmental variables.
Combine drivers to form scenarios.	2. Development stage: Construct a scenario space.	5. Define scenario logics.	6. Construct scenarios with a cross-impact matrix.
Narrow down scenarios.	2. Development stage: Select alternative worlds to be detailed.		5. Select scenario types.
Write descriptive narratives.	3. Reporting and utilization: Document	6. Elaborating scenarios.	6. Construct scenarios with a cross-impact matrix.
Make forecasts.	2. Development stage: Prepare scenario-contingent forecasts.		
Conduct SWOT analysis.	3. Reporting and utilization: Contrast the implications of alternative worlds.	8. Analyze implications for decision strategies.	
Conduct sensitivity analysis.		7. Analyze implications for key decision factors.	
Evaluate/develop strategies.	3. Reporting and utilization: Contrast the implications of alternative worlds	8. Analyze implications for decision strategies.	7. Analyze implications.
Challenge assumptions and policies.	3. Reporting and utilization: Contrast the implications of alternative worlds	8. Analyze implications for decision strategies.	7. Analyze implications. 8. Implement.
Devise contingency plans.			7. Analyze implications.

Step	Trend-Impact Analysis (page 3-46)	INTERAX (page 3-47)	BASICS (page 3-51)
Define purpose and objectives		1. Define issues and time period.	1. Define and structure topic.
Determine scope.		1. Define issues and time period.	1. Define and structure topic.
Gather information.	3. Identify trends and collect time series data.	4. Identify impacting events using database.	
Define drivers or variables.	1. Identify key drivers. 5. List impacting events. 6. Establish probabilities of events.	2. Identify key indicators. 4. Identify impacting events using database. 5. Develop event probability distributions. 6. Estimate impacts of events on trends. 7. Complete cross-impact analysis.	2. Identify areas of influence. 3. Define descriptors. 4. Complete cross-impact matrix, run simulation. 6. Introduce surprise events.
Combine drivers to form scenarios.	2. Create a scenario space.	3. Project key indicators. 8. Run simulation model.	4. Complete cross-impact matrix. run simulation.
Narrow down scenarios.			5. Select scenarios for further study.
Write descriptive narratives.	8. Write narratives.		
Make forecasts.	4. Prepare naive extrapolation. 7. Modify extrapolation based on steps 5 & 6.		
Conduct SWOT analysis.			
Conduct sensitivity analysis.			6. Introduce surprise events.
Evaluate/develop strategies.			
Challenge assumptions and policies.			
Devise contingency plans.			

Appendix B. Scenario Analysis Implementation Guide for the US Air Force

Instructions for use:

1. Read chapter III of this thesis to gain an understanding of the scenario analysis method.
2. Review the composite model illustrated in Figure 4-2 (page 4-6).
3. Work through this guide:
   - Read the questions.
   - For questions with blanks, fill in the blanks.
   - For questions with a choice of answers, circle the boldfaced answer you most agree with.
   - Refer to referenced tables or figures, as appropriate.
   - Consult the Guidelines for Implementation at the end of this Appendix for answers to some common questions.
4. Conduct further research as necessary.
5. Conduct scenario analysis.

Notes:

- The guide is meant to be only the starting point for using scenario analysis. The level of effort required to complete the analysis is dependent on the scope set by the analysts.
- In an effort to keep the guide at a manageable size, key concepts and techniques are mentioned only briefly, with the understanding that the analyst will refer to chapter III if more explanation is needed. The bibliography is also a useful tool for additional research. In short, **this guide is not designed to be used separately from the rest of the thesis.**

Part I: Determine the Level of Environment

Refer to Table B-1 on page B-4.

1. What is your purpose for conducting scenario analysis?

_____

_____

_____

_____

2. Compare your answer above to the following five planning tasks for which scenario analysis could be used. Circle the planning task that best describes your reason for conducting scenario analysis, and locate the appropriate column on the "Planning Task" portion of Table B-1.

- **Allocating resources** refers to the decisions an organization must make when allotting its resources among its subunits, including money, personnel, computers, vehicles, and the like.
- **Developing common assumptions** is the process by assumptions are discussed and agreed upon as a basis for decision making and planning. For example, this planning task could be used at an annual conference for supply commanders to orient each commander to the same perspective on future events. The commanders could then devise and implement strategies in their own squadrons using the same world-view as the rest of the command. This would be

particularly useful for uniting the thoughts and actions of people from different backgrounds. This task provides a single starting point from which to plan.

- **Identifying new opportunities and threats** refers to how an organization can search for new opportunities or threats forthcoming in the external environment.
- **Evaluating operational plans** is the testing of existing organizational strategies.
- **Evaluating specific projects** pertains to how the new organizational projects will stand up to alternate future environments.

3. For what level of the Air Force are you conducting scenario analysis?
Circle one, and locate the appropriate row
on the "Organizational Level" portion of the table.

- Department of Defense/Air Staff
- Major Command
- Wing
- Squadron
- Flight/Office

4. Use questions 2 and 3 together to find the intersecting quadrant on Table B-1.
This will recommend a level of environment to give boundaries for your scenario analysis effort. Examples of applications are also found on the table. Sample variables to use in your scenario analysis process are given in the accompanying narrative.

This table is designed to help an Air Force organization determine which level of environment to focus on when conducting scenario analysis. First, the planning task and organizational level should be determined and located on the table. In the appropriate square, a recommended level(s) of environment is given, as well as an example of a topic that would lend itself to scenario analysis at that level. The level of environment prescribes the scope of the study, giving boundaries to which variables should be included. The **five levels of environment** include global, defense, local, exploratory, and issue-oriented environments:

- The **global environment**, which is primarily used at the highest organizational levels, focuses on external variables such as the national economy, international relations, public opinion and political trends.

- The **defense environment** stresses the variables that are relevant to the defense industry as a whole. The variables may include the condition of the defense industrial base, defense budget levels, and the political, technological and social issues facing the industry.

- The **local environment** focuses on the lower organizational levels while holding the external variables (e.g. international relations) constant. It also considers some of the same variables but at a lower level (e.g. local community relations). Other variables impacting the local environment could include wing manning levels, squadron budget, the mission, and local leadership.

- An **exploratory environment** can be used by all levels within the DoD. This level of environment is scanned for new opportunities or threats that may impact the organization. Some variables to be considered include emerging technologies, political and military issues, and the capabilities of the defense industrial base.

- **The issue-oriented environment** focuses on more specific issues that affect the organization. If base closures were the issue, some key variables to consider would be wing missions, community relations, and environmental pollution.

5. Using table B-1 and the preceding discussion, what level of environment will you focus on for your scenario analysis? (Circle one)

- Global Environment
- Defense Environment
- Local Environment
- Exploratory Environment
- Issue-Oriented Environment

6. Using the preceeding discussion, what are some variables or drivers that would have a major impact on your scenarios? Write them down here. You can add to this list after you have selected a methodology, which will give more specific instructions.

Table B-1. Environmental Level Selection (an adaptation of Linneman and Klein, 1985:71)

	Planning Task				
Organizational Level	**Allocate Resources**	**Develop Common Assumptions**	**Identify New Opportunities**	**Evaluate Operational Plans**	**Evaluate Specific Projects**
DoD/Air Staff	**Global** Example: allocation of defense budget among military services	**Global** **Defense**	**Exploration** **Global** **Defense** Example: Coalition forces during Gulf war	**Global** **Defense** Example: Evaluate war plans, plans for outcome-oriented performance measures	**Issue Oriented** Example: Homosexuals in the military
MAJCOM	**Defense** Example: Base funding within each command	**Defense**	**Defense** **Exploration** Example: New weapons system acquisition	**Defense** **Global** Example: Evaluate exercises such as Team Spirit and Red Flag, MAJCOM strategic plans	**Issue Oriented** Example: Lean logistics
Wing	**Issue Oriented** **Local** Example: allocation of funds and vehicles among squadrons	**Defense** **Local**	**Exploration** Example: Establishing community partnerships	**Local** Example: Evaluate Wing mobilization plans, strategic plans	**Issue Oriented** Example: Construction projects
Squadron	**Local** Example: allocation of squadron funds and vehicles among subunits	**Local**	**Exploration** Example: New procedures or software programs	**Local** Example: Evaluate war plans, functional strategies	**Issue Oriented** Example: Self-help programs, squadron reorganization

Part II: Select a Methodology

The composite model presented in Figure 4-2 can be used to structure the scenario analysis, but more specific guidance for scenario construction or for applications of the results may be needed. This section of the guide helps determine which type of method should be used, from basic to complex and from qualitative to quantitative. Work through the following questions and then refer to Table B-2 (page B-6) for recommendations of other methods to research. A brief summary of the methods is found on pages B-7 and B-8.

A. Basic or Complex

1. Who will be involved in the scenario analysis process?

_____

_____

_____

_____

2. Do they have a high level of forecasting or planning experience?

No	Yes
Consider using a basic method.	Consider using an intermediate or complex method.

3. Who are the stakeholders in the process (e.g., managers, planners, people who will use the results of the scenario analysis)?

_____

_____

_____

_____

4. What kind of process would best help the stakeholders to understand and trust the results, a basic method or a complex method?

A basic method.	A complex method.
Consider using a basic method.	Consider using a complex method.

5. Will you be pressed for time to finish the scenario analysis?

Yes	No
Consider using a basic method.	Consider using an intermediate or complex method.

6. Looking over questions A-1 through A-5 and your responses, do you favor a basic, intermediate, or complex method for your scenario analysis? (Circle one).

Basic **Intermediate** **Complex**

B. Qualitative/Intuitive or Quantitative/Analytic

1. Are the people who will be conducting the scenario analysis more comfortable with and experienced in qualitative/intuitive processes or quantitative/analytic methods?

Qualitative/Intuitive	Quantitative/Analytic
Consider using a qualitative/intuitive method.	Consider using a quantitative/analytic method.

2. Are the stakeholders who will be using the results of the scenario analysis more comfortable with and experienced in qualitative/intuitive processes or quantitative/analytic methods?

Qualitative/Intuitive	Quantitative/Analytic
Consider using a qualitative/intuitive method.	Consider using a quantitative/analytic method.

3. Are the variables you will use to create the scenarios easily quantifiable?
See your list on page B-3, number 6.

No	Yes
Consider using a qualitative/intuitive method.	Consider using a quantitative/analytic method.

4. Looking over questions B-1 through B-3 and your responses, do you favor using a qualitative/ intuitive method or a quantitative/analytic method for your scenario analysis? (Circle one).

Qualitative/Intuitive **Quantitative/Analytic**

C. Select a Methodology

Use your responses in questions A-6 and B-4 to select the area on table B-2 that applies to your scenario analysis project. The names given in that area refer to different methodologies for conducting scenario analysis.

	Methods Used for Scenario Construction	
Complexity of Total Methodology	**Primarily Qualitative/Intuitive Methods Used**	**Quantitative/ Analytic Methods Used**
More Basic	Foster	
↓	Jain	MacNulty
	Atlantic Richfield	Trend Impact
Intermediate	Chapman	
↑	Becker	
	Schoemaker	INTERAX
↓	Boroush & Thomas	BASICS
More Complex	Intuitive Logics	Mesavoric & Pestel

Table B-2, Scenario Methodology Selection Matrix

Brief Recap of the Methods

Primarily Qualitative/Intuitive Methods Used for Scenario Construction

- **Foster**- an appropriate model for a small organization. Gives examples for implementation by a housebuilder, a restaurateur, and for a Hong Kong entrepreneur. For more information, see Foster's 1993 article referred to in the bibliography.

- **Jain**- a basic five-step method that uses an intuitive method to create the scenarios and then prepares an extrapolative forecast for the most likely scenario. For more information, see Jain's 1986 article referred to in the bibliography.

- **Atlantic Richfield**- a method used by the Atlantic Richfield Company to predict oil prices. Uses intuitive methods to develop the scenarios, and then uses an econometric model to forecast the variable of interest. Uses analysis of the risks and opportunities, and has a feedback loop. For more information, see Jones's 1985 article referred to in the bibliography.

- **Chapman**- a qualitative method that makes a forecast for the variable of interest for each scenario generated. Emphasizes "determining" the future based on current policy decisions. Demonstrates the method with a United Kingdom energy policy example. For more information, see Chapman's 1976 article referred to in the bibliography.

- **Becker**- Sets a range for each variable, combines them to develop three scenarios: optimistic, pessimistic, and most likely, and projects a forecast for each scenario. Becker's article illustrates the use of scenario analysis to estimate market conditions in the US and to analyze strategies for a manufacturer of medium and heavy trucks. For more information, see Becker's 1989 article referred to in the bibliography.

- **Schoemaker***- a generic model that attempts to generalize other models. Involves consideration of stakeholders, and constructs two forced scenarios (purely optimistic and purely pessimistic) as bounds for the scenario space. For more information, see Schoemaker's 1993 and 1991 articles referred to in the bibliography.

- **Boroush & Thomas***- uses a handy scenario space chart to develop scenarios. Has an easy to follow example applying the method to the defense industry. For more information, see Boroush and Thomas's 1992 article referred to in the bibliography.

- **Intuitive Logics***- Designed to help managers question assumptions and define perceptions about future environments in order to make better decisions. Emphasizes the use of the human brain to synthesize information and to think creatively. For more information, see Huss and Honton's 1987 article and Wack's 1985 articles (for applications at Shell Oil) referred to in the bibliography.

Quantitative/Analytic Methods Used for Scenario Construction

- **MacNulty-** a detailed cross-impact model with hundreds of interrelationships managed by hand. The steps seem out of order, but are useful in providing a basis of understanding for the more complicated computerized cross-impact models such as BASICS and INTERAX. For more information, see MacNulty's 1976 article referred to in the bibliography.

- **Trend Impact*-** a straightforward method in which judgmental factors are employed to adjust extrapolated statistical forecasts. For more information, see Huss and Honton's 1987 article and Bunn and Salo's 1993 article referred to in the bibliography.

- **INTERAX*-** a heavily quantified model which uses estimated probabilities as inputs to a simulation program. Developed with the support of 12 large US corporations, including General Motors, Pratt and Whitney Aircraft, and Exxon. Use of the database and simulation program is available for a fee from the USC's Center for Futures Research. For more information, see Huss and Honton's 1987 article and Enzer's 1981article referred to in the bibliography.

- **BASICS*-** a cross-impact simulation program that factors in surprise events and prints out descriptive narratives. Can run on a personal computer. The Battelle Memorial Institute offers instructional hands-on workshops for their BASICS method. For more information, see Huss and Honton's 1987 article and Bunn and Salo's 1993 article referred to in the bibliography.

- **Mesavoric and Pestel-** A complex computer model that has been used to show a hundred thousand interrelationships between variables to develop detailed world scenarios. For more information, see page 3-X in the literature review, or Zenter's 1982 article and Meadow's and Mesavoric and Pestel's books referred to in the bibliography.

* Especially helpful models are marked with an asterisk.

For More Information:

For more information on any of the methods, see the table of contents to find the page number reference to chapter three, where you will find a discussion of the method and citations to the original references. Additionally, Appendix A has tables comparing the steps in each model to our composite model described on page 4-1 and following.

Remember that any of the methods can be adapted or modified to suit the needs of your scenario analysis project. For example, you can use MacNulty's manual cross-impact method, or design your own computerized version without buying INTERAX or BASICS's services.

Part III: Determine Your Approach

After selecting a level of environment and an appropriate methodology, you still have some choices to make about your approach. This section will help you determine what approaches to use in constructing your scenarios and conducting scenario analysis.

A. Progressive or Snapshot

A progressive scenario describes events as they occur and lead up to a point in the future. A snapshot scenario describes the future environment at a point in time, but does not trace how the environment developed from your present time. Use your answers to the following questions to choose which style you will use to write the narratives for your scenarios.

1. Do you want to use the results of your scenario analysis to help you detect the beginnings of trends as they occur?

Yes	No
Write progressive scenarios.	Write snapshot scenarios.

2. Do you want insight into cause-and-effect relationships between key variables or elements in your environment to assist your organization in setting policies?

Yes	No
Write progressive scenarios.	Write snapshot scenarios.

3. Are you going to use scenario analysis in an abbreviated form as a training aid for managers to better understand the different possibile conditions of the future environment?

No	Yes
Write progressive scenarios.	Write snapshot scenarios.

4. Are you pressed for time in doing your scenario analysis project?

No	Yes
Write progressive scenarios.	Write snapshot scenarios.

For more information, look up the following references in the bibliography: Becker, 1989 and Schnaars, 1987.

B. Trend or Surprise

A scenario can be written by drawing out rather predictable trends and projecting them into the future. Alternatively, a scenario can be written by assuming the occurrence of an improbable event and describing the results and impacts. There are also many combinations of both. For example, trend impact analysis generates consistent trend scenarios, and then factors in the impact of surprise. Additionally, sensitivity analysis could be performed on a scenario to see the impact of a improbable event occurring. On a very limited scale, surprise can be introduced by using just two scenarios: the most likely (basically a trend scenario), and the most pessimistic. The scenario

most detrimental to your organization could involve some events that are highly unlikely, but that would be devastating if they occurred, and should be considered in forming a robust strategy. Use the following questions to determine your approach.

1. Is your organization's environment highly stable and expected to stay that way for some time?

Yes	No
Developing only trend scenarios may be sufficient.	Consider elements of surprise in your scenario development process.

2. Do you have enough time and/or personnel to handle a larger number of scenarios?

No	Yes
You may not be able to handle all of the elements of surprise.	Consider elements of surprise in your scenario development process.

3. Would an unexpected change in the environment impact your organization heavily?

No	Yes
Developing only trend scenarios may be sufficient.	Consider elements of surprise in your scenario development process.

For more information, look up the following references in the bibliography: Schnaars, 1987 and Ducot and Lubben, 1980.

Part IV: Conduct Additional Research and Conduct the Scenario Analysis

Conduct additional research as needed to feel more confident on the use of scenario analysis and various approaches to it. Chapters III and IV and the Bibliography may be useful at this point. Use the chosen methods and recommendations from this guide to conduct the scenario analysis, and make appropriate applications.

Guidelines for Implementation in Question and Answer Form

Who should develop the scenarios?

- Scenarios should be developed by a group of people from different departments within the organization. Great benefits are realized by involving people with different viewpoints. The resultant scenarios encompass a greater range of possibilities and are more realistic. Also, the people involved in the process can understand the methods used in formulating the scenarios, and are more likely to accept and use the results in their business decisions.

Can one person do scenario analysis?

- According to Becker (1989:63), scenarios are limited if one individual develops them for the organization. These scenarios will be limited by the individual's personal opinions and biases rather than being the product of a systematic methodology. The scenarios often have internal inconsistencies and predict mutually exclusive events that cannot happen in a certain sequence, or events that cannot both occur at the same time. Identifying and removing the inconsistencies is particularly difficult for a lone author. However, the single author can still benefit from the exercise as training in wider-oriented futures thinking.

How can the concepts of scenario analysis be applied on a smaller scale?

- Provide top leaders with headlines, have them write out newspaper stories. "As part of their strategic vision of their company's future, most CEOs carry around a set of unarticulated scenarios. To draw them out, we give CEOs headlines about their company or industry that could appear in *Business Week* in the year 2000, then ask them to fill in the story behind the headlines" (Morrison, 1994:24).

- Challenge leaders with "untrends" - turn a common assumption upside down and ask participants to brainstorm causes that could lead up to this reversal (Morrison, 1994:20).

What time horizon should we use?

- Schnaars (1987:108) presents two determinants for choosing a time frame for scenarios: how far in the future you are committing resources, and the length of time over which large changes in the environment can be expected to occur.

- Linneman and Klein (1985:71-72) report the majority of companies that perform scenario analysis use a five year time horizon. However, they suggest the company set its time horizon according to its reaction time. The reaction time is the time it takes the organization to respond to the environmental change. If the company uses a five-year planning horizon and they do not wish to change it, then they may consider using a scenario approach that has a span of ten to twenty years. This approach would help management identify some of the opportunities and obstacles that lie ahead.

- Chapman (1976:4) states that anything over 50 years is purely fictional because there are too many variables that could change in that amount of time. "The time period should be short enough so that the technical possibilities are known," but long enough to project beyond certainties in the environment. Shell Oil uses scenarios with 15 year horizons or more, with the content growing more vague for the distant years (Schnaars, 1987:108).

How many scenarios should we work with?

- The recommended number varies from author to author, and may also depend on your purposes for conducting scenario analysis. Most of the authors recommend constructing several scenarios, and then narrowing them down to a manageable handful, such as five or less.

- Too many scenarios can increase the complexity of the decision making process thus creating confusion. Linneman and Klein (1985:73) report management has difficulties in dealing with large numbers of scenarios. It is suggested that firms new to scenario analysis employ no more than two or three. If an organization is conducting an environmental assessment based on probabilities of occurrence, then they should use three scenarios. According to Linneman and Klein the first scenario should reflect the present situation, and the second and third scenarios should portray the most pessimistic and optimistic outcomes.

- Chapman argues that "the minimum number of options is probably three; reducing the exercise to a binary choice seems too polarized and unrealistic." Each scenario may have subsidiary options or branches. The number of options and branches should be restricted so they can be studied and analyzed sufficiently, but there should be enough to cover a wide range of choices. Because of the decreasing accuracy of forecasted data over time, it is futile to analyze a large number of closely spaced scenarios. Using a few, widely-spaced scenarios is preferable, although painting a black and white picture of future possibilities should be avoided (Chapman,1976:4-9).

- If you're limited for time or in your ability to manage a number of scenarios, Foster (1993:125-126) recommends picking two scenarios -- the most likely and the most pessimistic.

How do we narrow down which scenarios to focus on?

The goal of scenario analysis is not to find the most likely scenario, but rather to identify the different scenarios that are possible. According to Schnaars (1987:108-109), you can limit your number of working scenarios based on any of four considerations:

- **Favorability to the Sponsor**: Pick the most optimistic and the most pessimistic scenario, and use them as alternatives to the baseline or "surprise-free" scenario.
- **Probability of Occurrence**: Work with scenarios on the basis of their probability. Cross-Impact Analysis takes it a step further by assigning probabilities to the scenarios and then rank ordering them according to these probabilities. One of the criticisms of this method is that there is no evidence to support the assigned probabilities. Scenarios are possibilities, not probabilities.
- **Single, Dominant Issue**: Select a few scenarios that represent different conditions of your key factor, for example: inflation, a stable economy, and recession.
- **Themes**: Select a few scenarios that emphasize different aspects of the future environment, for example: "economic expansion," "environmental concern," and "technological domination."

Should we develop the scenarios from the present time to the future, or work our way backward?

- The best approach is to do both. The forward approach starts at the present time with a set of assumptions and projects them into the future. The result is logical, consistent, comprehensive scenarios. However, some important considerations may be missed. The backward approach starts by describing different possible future environments, and then traces each one back to the present time by reasoning plausible sequences of events that could have led up to them. The best method is use both approaches in constructing scenarios.

What can we do to make our scenarios consistent and credible?

- Schoemaker (1993:196) encourages scenario developers to check their scenarios for consistency in three areas: trends, outputs, and the reactions of stakeholders. Also, Bunn and Salo (1993:299-301) offer practical guidelines for achieving dimensions of credibility, consistency, and coherence.

How can we look at the scenarios with unbiased thinking?

Bunn and Salo (1993:299-301) offer four recommendations for neutralizing cognitive biases:

- Ask the participants to justify their reasoning and subjective assessments.
- Spend extra time on threatening and undesirable scenarios.
- Encourage the participants to imagine circumstances that would make their stated assumptions incorrect.
- Keep scenarios balanced in structure, length, and vividness of presentation.

What are some guidelines for using scenario analysis effectively?

- **Get top management involvement.** If top management is not involved in the scenario development process, the results will have little effect on decisions made. To be convinced of the plausibility of the scenarios, management must be involved at the beginning of the development stage rather than the end of it. This involvement will ensure that the scenarios are consistent with their views and will lessen the difficulty of trying to "sell" them the final product. It will also reduce the amount of surprise should there be any controversial or disappointing scenarios (Linneman, 1985:67).

- **Keep it simple.** Linneman and Klein (1985:69) found that most companies prefer to use simple scenarios because management is uncomfortable with sophisticated methods. In large companies such as the oil industry, many strategic planners avoid the complex scenarios because they tend to "appear highly academic and impractical" to line managers.

- **Give the scenarios distinct themes** to prevent managers from simply picking the middle scenario of three and ignoring the other two, which would be like using a single point forecast (Schnaars, 1987:108).

- **Use the scenarios to test current actions.** Chapman discusses scenario construction from a proactive perspective: "the scenario approach emphasizes the degree to which the future is a matter of choice and can be influenced by policy decisions" (Chapman, 1976:2).

- **Develop scenarios that focus on the critical issues.** Since there are an infinite number of variables that could be considered, it is critical to focus only on the issues that directly affect the situation. Without this focus, the task of building a scenario will become enormous (Boroush and Thomas,1992:28-29).

- **Employ the collective wisdom of the organization.** This will foster a team building atmosphere, gain commitment to the process, obtain a broader variety of insights, develop more comprehensive scenarios, increase the credibility and acceptance of the scenarios, and train managers to think more realistically about the future (Werner, 1990:56).

- **Save the quantitative forecasting analysis for the latter part of the scenario building process.** Try to begin the process using only qualitative information. Quantitative information is necessary to provide unambiguous assumptions, however, it tends to obscure some of the uncertainties that must be introduced in the initial stages of the scenario. Boroush and Thomas found that qualitative discussions during the early stages of scenario building give a better understanding of the "discontinuities" and also set a better stage for the use of the forecasting models (1992:28-29).

What actions could management take to implement the use of scenario analysis?

The following action steps are recommended by Millett (1988:67):

- Assign responsibility to several key analysts to monitor and document environmental trends such as economics, demographics, customer behaviours, regulations, technologies, and competitors.
- Integrate the trend analyses into comprehensive scenarios with at least a 10-year horizon.
- Communicate the scenarios widely by oral briefings and short (5-10 page) written summaries.
- Encourage managers to think about appropriate corporate strategies by participation in group dynamic sessions and/or computer simulations.
- Update, evaluate, and revise the scenarios annually; construct whole new scenarios at least once every 3 years.
- Incorporate the scenarios and candidate strategies in periodic planning reviews and documents.
- When strategies and policies are announced, use the scenarios as a basis for explaining what needs to be done and why in order to achieve specific goals.

What obstacles could block the successful introduction of scenario analysis into an organization?

- An organizational attitude that is not conducive to a high level of planning. For scenario analysis to be effective, planning should be seen as a valuable activity, and it should be backed by senior management. There should be a desire to improve planning and resources committed to it.

- Personnel who do not know how to use even straightforward, formal inputs.
- An organizational structure or corporate culture that would require major change to implement scenario analysis.
- Hamilton (1981:85-87) recommends that scenario analysis be introduced for limited applications or in particular areas where resistance is at a minimum for visibility and experience. Later, more general applications could be introduced.

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With the uncertainties in the current Air Force environment, extrapolated forecasting methods are no longer sufficient for meeting the Air Force's strategic planning needs. The Air Force could benefit from using a more sophisticated method to determine the opportunities and obstacles it will face in the future. The key characteristics that distinguish scenario analysis from other forms of forecasting are the qualitative, contextual descriptions of the future environment, and the identification of several possible futures. This thesis discusses the concept of scenario analysis and its relevance to the Air Force as a strategic planning tool. It begins with an overview of strategic planning and forecasting concepts. The current literature on scenario analysis is then integrated into a single reference discussing general concepts, construction methodologies, and corporate applications. The various approaches to scenario analysis are compared and incorporated into a composite model. Appropriate applications of scenario analysis within the Air Force are discussed, and a step-by-step guide is presented to assist Air Force managers and planners in implementing scenario analysis.

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