represented by the shaded area of the normal curve in the graphic below.
(see: *normal distribution, significance test*)

zero-sum game—a particular class of problems dealt with by game theory. The zero-sum game is a special case of the fixed-sum game, which describes purely competitive situations in which one player's gains are equal to the other player's losses. No cooperation between players is possible in these games where the sum of the payoffs to the two players in each cell in the matrix is set at some constant value. (It is set at zero in the zero sum case, but any value will do in general.) (see: *GAME THEORY, fixed-sum game, saddle point*)

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TECHNIQUES

ACTION THEORY—a body of thought identified with structural-functional analysis, in which the basic units of analysis are the social and political actions of individuals. Action in the political sense usually relates to the efforts of political decision-makers in making and implementing public policy, or to the behavior of states in the international arena. Analysis of the patterns of action can lead to an understanding of political decisions and, in some cases, provide a basis for prediction. (see: *STRUCTURAL-FUNCTIONAL ANALYSIS, political action*)

ANALYSIS OF VARIANCE (ANOVA)—a procedure for making a statistical inference about the source of two or more sample groups. The intent is to compare the mean values of the samples in order to discover whether or not the samples were drawn from the same overall population. The results, read from an F table, then tell how often the observed variability in the sample means could be expected to result from mere random fluctuation, and how confident we may be in the conclusion that at least one of the observed samples was drawn from a different population. Analysis of variance can be used, for example, in analyzing voting results. If we know the average vote for a particular party's candidates in each of several regions, *ANOVA* will tell how likely it is that some special factors other than just chance variations have uniquely influenced the voting in one of the regions, without significantly affecting the others. This alerts us to any special characteristics of the unusual area, and further investigation can be directed toward it. (see: *F test*)

BAYESIAN ANALYSIS—a formal method for using incoming data to modify previously estimated probabilities. Each new piece of information may be evaluated and combined with prior historical or subjective assessments of the probability of an event in order to determine whether its occurrence has now been made more or less likely, and by how much. Bayesian analysis can also be used to compute the likelihood that the observed data are attributable to particular causes. One advantage claimed for Bayesian analysis is its ability to blend the subjective probability judgments of experts with historical frequencies and the latest sample evidence.

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BEHAVIORALISM (not to be confused with behaviorism)—an orientation toward the study of social phenomena which is characterized by empiricism, quantitative data manipulation, and applied research. This is distinct from the traditionalist attitude, which relies more heavily upon historicism, introspection, and intuition. Within the last 30 years behavioralism has received widespread acceptance, especially in psychology, economics, and political science. It is partially an attempt to make the social sciences more "scientific" (i.e., more like the natural sciences) with a concern for rigorous research methodology, empirical observation, and numerical information. (see: *behaviorism*)

BUREAUCRATIC POLITICS—a generic term for a theoretical approach to the study of the interplay between individuals within organizations or governments. The approach focuses primarily upon the goals, motivations, and incentives of important individuals in the bureaucratic hierarchy and attempts to predict the outcomes of their decisions which are often less influenced by the substantive issues at stake than by personal preferences and infighting.

In his book, *Essence of Decision*, Graham Allison uses the bureaucratic politics model (which he calls Model III) to analyze the decisions made during the Cuban missile crisis of 1962 by the US and USSR. He visualizes the US and Soviet governments not as unitary actors or as aggregations of organizations, but as arenas of competition between individuals. Allison proposes that the process of decision-making through bureaucratic politics is analogous to the process through which the international system comes to be what it is at any given moment—a balance among the various powers that make it up. (see: *rational actor model, ORGANIZATION THEORY*)

CASE STUDY—research aimed at uncovering detailed information about a particular political event or phenomenon. The case study deals with a single observation or event, as contrasted with comparative studies or the sampling of many cases through some form of survey research. Case studies are, however, often used to generate hypotheses and to test hypotheses as they apply to a specific event. (see: *SURVEY RESEARCH, hypothesis*)

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CLUSTER ANALYSIS—a technique for the orderly classification of objects or individuals into small groups on the basis of shared characteristics. A large, unorganized collection of items with many different attributes is divided into smaller similar subgroups. Cluster analysis clumps together individuals who are as alike as possible, and as different from those in the other groups as possible. There is an element of arbitrariness as to precisely where to draw group boundaries—they may overlap or they may be forced apart. Some cluster techniques split hierarchically with smaller groups nested inside broader ones.

Cluster analysis differs from *DISCRIMINATION ANALYSIS* in that the former discovers groups while the latter begins with recognized groups and assigns new individuals to them. An example of a hierarchical cluster analysis would be an attempt to determine the likely coalitions and factions within the ruling elite in a given country. By examining family ties, jointly held political ideologies, common economic interests, etc., a cluster analysis can predict who the likely partners are, and how they will combine with others to form larger united groups on various issues.

The Rice-Beyle cluster-bloc technique is a method for processing votes in such a way as to reveal clusters of agreeing voters. Once the issues to be analyzed are selected, the frequency with which every voter agrees with every other voter, and a matrix of agreement is constructed. The highest agreement scores are than selected and "clustered" together. The computations are laborious and usually done by computer.

COHORT ANALYSIS—studies which examine the impact of political variables upon members of different age groups or other time identified groups. Suppose an analyst wants to compare the nature of political attitudes between two generations (say, under 40 and over 40) in a given government. Using cohort analysis he can measure the two groups at the same time. Alternatively, he could measure the younger group once, and again 20 years later, to ascertain changes in political attitudes with increasing age. (see: *PANEL STUDY*)

COMMUNICATIONS THEORY—a body of thought that seeks to explain processes of information sending, receiving, storing, and utilization as they relate to a political system. Communication is the means by which a political system receives and acts upon demands and develops policies. Information concerning the effectiveness of the system's policies and decisions

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on the environment is termed *feedback,* and the extent to which the system is able to adjust to feedback information helps to determine its effectiveness as a political system. Communications theory also relates to the ways in which attitudes and images are built up in the minds of decision makers and the way they affect perception, values, goals, and decision-making. A communications analysis of the relations between two governments, for example, might study the ebb and flow of communications of all types (letters, governmental statements, official visits, private travel, economic transactions, etc.) between the two.

COMPARATIVE POLITICS—the determination of differences and similarities between two or more units of analysis. A political event or case can be compared with other similar cases, with hypothetical cases, or with cases occurring in a time sequence. Contemporary applications of comparative politics include studies of specific political events, analysis of local, national, and cross-national institutions and systems, and comparisons of political behavior on all levels. *CROSS-CULTURAL ANALYSIS,* by contrast, compares different political cultures—or patterns of beliefs, feelings, and orientations toward government and politics within societies—while *CONTEXTUAL ANALYSIS* studies the interaction between a single political system and its environment.

COMPUTER CONFERENCING—a general term for a variety of techniques for communicating via computers. Often circumstances make actual meetings or face-to-face discussions impracticable or unproductive: time may be urgent, expenses high, psychological inhibitions may intervene, etc. Computer teletypes can provide immediate, convenient, anonymous interaction free from many of these constraints. This mode of conferencing also has an advantage over actual meetings in terms of convenience. The participants can use the computer terminals at any time without rearranging their schedules—they do not need to coordinate with everyone else for one set time period. Additionally, if the conference is not to be held in strict anonymity, the computer allows the participants the ability to send messages to certain selected individuals—a kind of "whispering" which does not often occur in actual group meetings. These directed and private communications permit the formulation of joint positions between individual participants before presentation to the others.

CONFLICT BEHAVIOR ANALYSIS—a social/psychological method which studies aggressive human behavior to understand, describe, and predict political behavior. Conflict behavior can be studied either as it appears domestically as political instability, or internationally as inter-state conflict. The Dollard-Doob (frustration-aggression) hypothesis, for example, maintains that aggression is always a consequence of frustration which ensues when goal-oriented behavior is thwarted. According to the Dollard study, an extra amount of energy is mobilized whenever a barrier is interposed between a person and his desired goal. This energy mobilization, if continued and unsuccessful in overcoming the barrier, tends to overflow into generalized destructive behavior. The degree of frustration and the number of frustrated response-sequences determine the degree of aggression.

CONTENT ANALYSIS—a technique for systematically coding and evaluating speeches, essays, broadcasts, etc. in order to make specific inferences about their origin, author, sponsor, intended audience, or other elements of the environment. It may simply count the number of times certain words and phrases appear or it may code the tone or meaning on a scale like friendship/hostility. With a computer, comparisons may be made, for example, of the reactions of two individuals on a particular issue, or of the trend in one individual's speeches. By noting the incidence of key words and phrases, content analysis can also determine which of several speeches or essays were written by the same individual. This knowledge can then be used to gauge the relative influence of certain advisors, or to discover factions and coalitions within the inner circle of a government.

CONTEXTUAL OR CONFIGURATIONAL ANALYSIS—study of the interaction and relationship between a particular political system and its environment, including other political systems. Studies which relate a political system to its physical and social environment excluding other political systems, are termed *ECOLOGICAL ANALYSIS*. (see: *ECOLOGICAL ANALYSIS, political system*)

CORRELATION—a statistical technique for measuring the closeness of the relationship between two variables. The coefficient of determination, tells what percentage of the variation in one factor can be explained or predicted solely by knowledge of the other factor. Multiple correlation is

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used to measure the relationship of one factor (the "dependent variable"—the one we want to predict) to two or more other factors (the "independent variables"—the ones used as predictors.) We compute the coefficient of multiple determination, R^2, to tell what percentage of the observed change in the dependent variable may be accounted for by the fact that the independent variables change. To determine how much variation is attributable to each of the independent variables separately we compute partial correlation coefficients. These resemble the coefficient of determination except that they measure the degree of relationship between the dependent and independent variables if the rest of the independent variables had been held constant instead of fluctuating as they actually do. Correlation alone can not be used to establish causality. Generally it tells only that two variables are associated, that they move together or that they do not. It can not tell which one causes the other.

Correlation, which tells how closely two variables are related, is often used in conjunction with *REGRESSION* analysis, which describes the precise form of the relationship.

COST BENEFIT ANALYSIS—The appraisal of anticipated expenditures needed to accomplish given objectives, in relation to the value of expected gains. Examining the ratio of benefits to costs helps decision makers to determine which among several alternative courses of action may offer the opportunity for the most effective use of resources. *COST EFFECTIVENESS* is a related form of analysis that is applied to ongoing programs to evaluate their relative progress toward the achievement of goals sought.

CROSS-CULTURAL ANALYSIS—the comparative study of the political cultures—or patterns of beliefs, feelings, and orientations toward government and politics—of several societies in order to describe, explain, and understand the differences and similarities between them. (see: *political culture*)

CROSS-IMPACT ANALYSIS—a forecasting method which examines the inter-relationships between variables to determine how a change in the probability of occurrence of one event will affect the probabilities of future related events. For example, many events would affect and simultaneously be affected by the advancement of European integration.

Once the probability of occurrence of each of these events is decided, a cross-impact matrix is constructed which lists events by number across the top and down the left side of the matrix. The probability of each event's occurrence is written above the event number across the top. The probability of event #6 occurring—"further enlargement of the EEC"—is 18%. Changes in the probabilities of other events by the occurrence of event #6 are then read from the matrix. If event #6 occurred, for example, the probability of event #2—"stabilization of the European money market"— would be increased from 55% to 86%. The probability of event #7—"continued independence of French military from NATO or European defense community"—is reduced from 53% to 38% by an increase in European integration. From this kind of analysis, we can predict the likihood of conceivable future events, given the occurrence of one event.

Cross-impact Matrix of Events

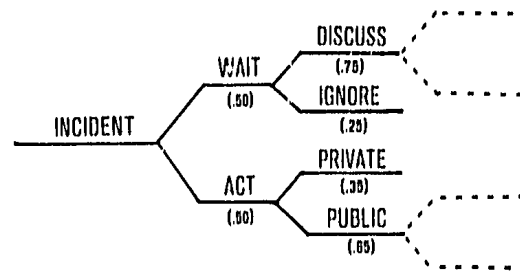| PROBABILITIES	21	55	57	18	53	75	48	67	33	76
EVENT NUMBERS	1	2	3	6	7	8	9	10	11	12
1					53		82	35	74	
2				28		53		80		76
3										76
6		86			38		27		18	91
7	21				13		52		35	76
8		39							33	
9	36			10	57			80	36	
10									33	
11	47			10	57	75	53	62		62
12		55	57	22	53				27	

DECISION-MAKING ANALYSIS—a method of analysis used to gain an understanding of the way a political system functions through observing and analyzing its decision processes: perception of the problems, marshaling facts and information, considering alternatives, and choosing a course of action calculated to gain chosen objectives. The decision-making analyst tries to answer such questions as what was the decision, who made it, how was it made, why was it made, what impact did the environmental situation have, and what do these answers tell us about the functioning of the political system that produced the decision. Decision-making analysis usually assumes rational behavior on the part of decision-makers, so, generalizations concerning political behavior can be made.

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DECISION THEORY—a body of knowledge and related mathematical techniques drawn from statistics, mathematics, and logic designed to select the optimal decision or chain of decisions under conditions of uncertainty. Begin by listing the opening alternatives and the probabilities of various future conditions. Additional choices may be required by each future state. The series of alternatives branching from each decision point is graphically shown in a decision tree. The analyst can then assign probabilities and compute the expected payoffs from each policy.

Decision analysis encourages a wider scan of alternatives and a thorough search for future possibilities. It is similar to *GAME THEORY* except that in game theory, decisions involve an intelligent opponent player while in decision theory, the only opponent is nature, with its related uncertainty. Thus, in situations where the opponent can be expected to act in a fashion designed to maximize his own expected returns, game theory is the more appropriate analytical tool. If the opponent plays random or non-purposeful strategies, decision theory is the more accurate model.

DECISION TREE—a method of calculating the probability of a series of events by listing all possible decisions and their probabilities following each previous decision in a series. A sample decision tree may list the courses open to a government in reacting to a hostile incident with a foreign nation. The first decision is whether or not to act immediately. If not, the upper branch of the tree is followed and the decision must then be made whether to discuss the event at an upcoming conference, or to ignore it all together. If, on the other hand, the government decides that immediate action is necessary, it follows the lower branch of the decision tree. The decision it now faces is whether to protest publicly or in private, and each of these options entails further choices, as suggested by the remaining unnamed branches of the decision tree.

The end of the tree indicates the probability of success of each combination of policies in preventing a repetition of the original incident. Since the policies also have different costs in terms of risk and political expense, the government will not automatically opt for the combination of policies which provides the highest likelihood of success, but calculations of this type might influence the ultimate decisions.

```
                                    DISCUSS  ,-------
                          WAIT    /   (.75)  ,
                          (.50) /   IGNORE    `-----
        INCIDENT        /          (.25)
                       \          PRIVATE
                          ACT    /   (.35)  ,-------
                          (.50) \  PUBLIC   ,
                                    (.65)    `-------
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DELPHI—a technique for generating and evaluating a concensus of expert opinion. A sequence of individual questionaires is submitted, which may include in the second and successive rounds a defense of the respondent's position or comments on the other responses. Panelists are presented with the results and comments from the previous interrogations so that they have the opportunity to change their views in response to the arguments of the other participants. During the course of the series, the source of the various responses is never revealed to the participants. This complete absence of face-to-face confrontation minimizes the influences of unwanted psychological factors such as personality dominance of certain individuals and the unwillingness to state unpopular views or to disagree with superiors or associates. On the other hand, the lack of direct interaction also eliminates the possibility of considering the source of an option when evaluating its validity.

DIMENSIONAL ANALYSIS—dimensional analysis is the starting point for evaluating the logic of a thought system—it checks whether the language used makes sense. For example, in conducting a voting study, we need to make certain that the census areas and the voting districts are identical, otherwise our demographic statistics and the polling results will not apply to the same areas. Moreover, some key census definitions may have changed over the years covered by the study: the terms "white collar worker," "literacy," and "poverty" may have different standards at different times. Dimensional analysis also concerns problems of expression. If one figure is written in dollars, for example, and another is expressed as a percentage, each must be changed into common units in order to be multiplied together.

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DISCRIMINATION ANALYSIS—a statistical technique for defining the best boundaries separating a number of recognized groups and assigning individuals to them. Beginning with a number of known groups and measurements of each individual, formulas are produced which describe the appropriate boundary lines. A "center of gravity" for each group is determined and measurements are made of the tendency to cluster or disperse around this center. Discrimination analysis is useful not only in confirming or amending the original group classification scheme, but in assigning new members to the proper groups. If we know, for example, that a particular country has three basic kinds of fighter aircraft, and that each kind has been observed in several widely differing prototypes, discrimination analysis can help categorize them. Based upon measurements of relevant characteristics, the planes will be divided into three similar groups, and new observations can then be assigned to the appropriate class. Discrimination differs from *CLUSTER ANALYSIS* in that the latter discovers groups, whereas the former begins with known groups.

DYNAMIC PROGRAMMING—a complex mathematical technique used in the solution of problems involving decisions which are grouped into stages which then are considered sequentially. The objective is to determine the optimal decision at each stage, with optimal referring to the entire problem rather than to the specific stage involved. Dynamic programming can be applied to a variety of mathematical models. For example, dynamic programming might be appropriate in preparing a contingency plan for a country's optimal post-war recovery program, because many variables and constraints would have to be included in order to determine optimal short and long run goals. (see: *DECISION THEORY*)

ECLECTIC APPROACH—a mode of analysis that draws from a variety of patterns of thought or methodologies rather than focusing on a single, comprehensive approach. An eclectic approach might combine, for example, the use of *CASE STUDIES, the SOCIAL/PSYCHOLOGICAL APPROACH, ELITE ANALYSIS, GROUP THEORY*, and *DECISION-MAKING ANALYSIS* to analyze and describe the politics of a certain nation.

ECOLOGICAL ANALYSIS—analysis of the relationship of a political system to its physical and social surroundings, excluding other political systems. Other political systems are regarded as part of the "context" rather than the "ecology" and the study of interaction between a political system and its context is called *CONTEXTUAL ANALYSIS*. Ecological analysis calls attention to the importance of environmental factors for the functioning of a political system and the reciprocal impact of the system upon its environment. For example, if a government in a developing country institutes a broad program of land reform, its impact on the physical, cultural, and social setting may be extensive. The results may involve a revolution in agricultural techniques, a developing sense of nationalism, and a general movement away from the traditional community to the large cities. These changes in turn may have important consequences for the maintenance of the political system. (see: *CONTEXTUAL ANALYSIS*)

ECONOMETRICS—a branch of economics which expresses economic theories in mathematical terms in order to verify them by statistical techniques. It is concerned with empirical, quantitative measurements, and with evaluation of the cross-impact of economic variables upon one another. An econometric model of GNP, for example, may include a series of 300 or more multiple regression equations. The data is based upon the historical records and the general forms of the equations are specified, in order to predict future values.

This description and extrapolation is not only a predictive exercise, but an explanatory one, attempting to define relationships between economic variables and to aid understanding of their effects. It may also suggest policy implications. Typically, the analyst knows which variables will be important in the equations, but not their specific values—this is supplied by econometric analysis. For example, an economist may know that construction spending, stock averages, and unemployment are among the important predictor variables for GNP; this analysis tells how to weigh them in making predictions.

ELECTION ANALYSIS—an application of *REGRESSION* analysis to relationships between voting results and census figures. Beginning with the polling statistics for several comparable regions, or for one region over a series of elections, the attempt is made to explain the observed fluctuations in the vote for one party or individual, and to predict future voting results.

Census data can provide the independent variables: differences in average income for the regions, unemployment, literacy, etc., which will affect the popularity of different political figures from region to region. Multiple regression analysis weights the importance of the different variables and describes the form of the relationship. It offers predictions based upon the best fit of the historical data.

ELITE ANALYSIS—studies aimed at explaining the nature and role of those groups or individuals in which decision-making power is highly concentrated. Some studies of American elites have indicated that a single power elite drawn from the economic upper class provides leadership for other elements throughout the political community. Conversely, *community power studies* conducted by political scientists have tended to reject the elitist model in favor of a pluralist model in which power is portrayed as diffused among many competing interest groups. Studies of foreign elites focus on the nature and role of the ruling group in authoritarian states, the elites that participate in the "modernization" process in developing states, and the various elites that function within democratic societies on the local, provincial and national levels.

ENDS-MEANS ANALYSIS—employed as an aid in problem solving and decision-making, ends-means analysis constitutes a systematic attempt to relate rationally selected techniques (means) to desired goals (ends) so as to maximize goal achievement. In each case, the means are tested and evaluated in terms of how well they perform in attaining predetermined ends. The application of ends-means analysis may vary from the wholly implicit to the use of rigorous, systematic causal models. (see: *DECISION THEORY, causal model*)

ENVELOPE CURVE FORECASTING—a predictive device which approximates general trends by extending the patterns of individual components. Envelope curves are especially useful in long range technological and environmental forecasting. For example, if we want to predict the dates by which various speeds of travel will be attainable, envelope curve forecasting can help consider the possibilities of various scientific breakthroughs. We graph time and speed, and chart the increasing velocities available from various modes of transport: horseback, trains, cars, planes, etc. Typically, each new system adds a great deal of speed at first, then gradually contributes less and less improvement, as its

technological possibilities are exhausted. A new breakthrough then occurs, bringing another sudden burst of improvement. Therefore, if we attempted to predict future speeds by following the trend line of any individual device alone, its own particular curve would almost certainly understate the appropriate long term expectations. An envelope curve avoids this problem by encompassing all the different individual curves and predicting future possible breakthroughs and trends.

EVENTS ANALYSIS—based on the theory that international relations result from the flows of discrete events or contacts between countries and that these flows are subject to minor and major fluctuations, events analysis keeps account of these flows in order to establish a record of international relations. There are two types of events to be tracked: the routine exchanges across national boundaries such as mail flows or tourists called *transactions,* and the public, political flows such as official visits or government communiques termed *interactions.* (see: *events data*)

EVOLUTIONARY OPERATION—an experimental procedure designed to improve an ongoing process by gradual variations in its controlling variables. If given a system or operation whose yield is a function of several different factors, evolutionary operation tries small changes in two or three elements to move the process toward better performance. Each incremental adjustment will suggest which variable to change, its direction and amount, until an optimal solution is reached by this empirical hunting and testing.

Experimentation of this sort is applicable to many sorts of problems: what combination of seed, fertilizer, irrigation, etc., makes a particular crop grow best in a certain area? What combination of give-and-take in a multiple issue negotiation process seems to elicit the most favorable response? What combination of army, navy, and air force arms spending provides the most efficient allocation? In a simulation model, experts might attempt estimates of the effects of these changes, perhaps enlisting a computer model, but in evolutionary operation, the actual changes themselves are implemented and tried out in the field. This provides a series of controlled experiments in order to find the optimal solution.

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FACTOR ANALYSIS—a group of methods for finding a few fundamental quantities (the factors) underlying many observed variables. The variables are first collected into related groups and a single measure is selected to represent each set. The new group of basic factors—fewer in number than the original variables—is easier to work with, to weight, and to summarize.

Factor analysis aims to cut out some of the duplication and overwork resulting from too much redundant data. For example, if we wish to categorize information on 300 political leaders in some country, it may be unnecessarily cumbersome to record and manipulate data on 20 or more variables—such as age, education, income, and social class—for each person. A simpler method would be to select only a few of the 20 variables to represent the rest. Factor analysis may show, for example, that eight of the variables are highly associated; they seem to measure approximately the same thing, and any one of them may be selected to represent the rest. If single variables can be found to summarize other groups of variables, the number of variables may be cut from the original 20 to just three or four. Any subsequent data manipulation will have only these variables to work with, and can dispense with the rest.

FIELD THEORY—an approach to social and political analysis that conceives of individuals and groups as acting within a "field" or "life space"—each actor's behavior being affected by his relationship to the particular configuration of forces in his "field." Taking countries as objects of analysis, for example, two forces or variables might be wealth and population. Countries could then be located in the "field," in relation to one another, at the points indicated by their respective wealth and population. Shifts over time in the location of such points, occasioned by attribute change, are indicated by *vectors* (represented on a chart by arrows of appropriate length and direction, or in mathematical models by other symbols).

The field theory approach views the world as a dynamic relationship of contending and complementary forces, with the objectives of identifying, describing, measuring, and fitting each attribute into its proper niche within the field and determining the general directions of the trends within the force field. In international relations, field theory has been applied to the study of relationships between state attributes and state behavior. (see: *attribute, actor, model*)

EXPERIMENTAL DESIGN AND ANALYSIS—a way of discovering which combinations of variable factors best influence an outcome by setting the different factors at various levels, performing experiments, and analyzing results. This is a trial-and-error process, designed to optimize output or discover causality by specifying a limited number of relevant variables and closely studying the effects of changes in them. This is similar to the technique of *EVOLUTIONARY OPERATION*, except that it does not necessarily focus on small, incremental changes.
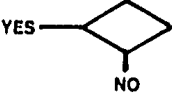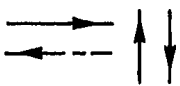
Experimental design and analysis can cover a wide range of possibilities, and clever design can single out those combinations of factors which seem most promising, thereby cutting down on the number of experiments which must be run. This technique can also indicate a confidence level (telling how certain we may be of the statistical significance of the observed data) and a sensitivity level (telling how much the output will vary due to relatively small changes in the input).

EXPONENTIAL SMOOTHING—a method of producing combined forecasts for a number of different time series by the simple blending of the last forecast and the last actual value. This is a process of combining a number of related elements into one, and of constantly updating the parameters based upon recent experience. For example, in predicting the annual defense budget of some country, accurate forecasts may have difficulty taking into account all the relevant factors. By blending in the values of the latest actual observation (i.e., the previous year's budget) a simple formula for modifying the prediction can be made. This method is often just as accurate as the more exhaustive techniques such as *REGRESSION* analysis. (see: *parameter*)

EXTRAPOLATION—a prediction of the future based upon a simple extension of present trends. Generally the most primitive test a new theoretical model undergoes is to determine whether the predictions it offers are more accurate than those of simple extrapolation. Often predictions based on trend extrapolation—for example, that the future will be essentially like the past—prove to be the most reliable forecasts possible from the available data.

FLOW CHART—an orderly representation of any process, organization, or system in which activities are defined and their interrelationships are illustrated in graphic form. Flow charting is applicable to analysis of any problem, but is used primarily in the initial stages of computer programming and modeling. Examples include a graphic representation of a bureaucratic hierarchy and the lines of communication and control within it; a description of a computer program or algorithm; and a picture of a store's traffic pattern showing where aisles interface, where queues form, or how traffic flows.

Flow charts are shorthand devices which contain written instructions, symbols, and occasionally equations. They should contain only enough information to show the activity at the given level of detail desired. Some of the more common flow charting symbols include:

Symbol	Represents
	PROCESS (Computation) A group of program instructions that perform a processing function of the program.
	INPUT/OUTPUT Any function of an input/output device (making information available for processing, recording processing information, tape positioning, etc.).
YES / NO	**DECISION** The decision function is used to document points in the program where a branch to alternate paths is possible based upon variable conditions.
	PROGRAM MODIFICATION An instruction or group of instructions which changes the program sequence.
	TERMINAL The beginning, end, or a point of interruption in a program.
	CONNECTOR An entry from, or an exit ot another part of the program flowchart.
	FLOW DIRECTION The direction of processing or data flow.

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FUNCTIONALISM—an umbrella approach covering a variety of analytic methods which focus on the *functions* of a political system (the results or consequences of actions which satisfy the needs or demands of the political system for its own maintenance) as a means of understanding and describing that system. (see: *STRUCTURAL-FUNCTIONAL ANALYSIS*)

GAME THEORY—a formal mathematical treatment of competitive and cooperative situations dealing with the individual decision process of rational adversaries—players who select the strategy which maximizes their return and minimizes their loss. Payoff matrices are constructed which show the outcomes and appropriate tactics of each player. For example, the optimum level of US defense spending depends in part upon the current level of Soviet defense spending, and a simple game theory matrix could show this situation in contrast to Game Theory situations—in which both players are actively seeking to advance their own self interest—are *DECISION THEORY* problems where only one of the players is considered rational (for example, an individual playing against the caprice of nature).

The most commonly drawn preliminary distinction in game theory is that between *non-zero-sum* and *zero-sum games*. In a zero-sum game, one player wins what the other loses. Examples of real-life zero-sum games are electoral races between two candidates for a single post, most military tactical situations, and bids by two contractors for a single project. Non-zero-sum games can be either cooperative or non-cooperative. In a cooperative game the players are permitted to communicate with each other and to exchange information in advance concerning their intended tactics. In a non-cooperative game, communication is not permitted, although the choice of each player becomes obvious after the play.

Games are also referred to by the number of players—*N-person games*. Games involving three or more players are much more complicated because the number of possible interacting strategies increases at an exponential rate with the number of players. N-person games are usually used to study coalition formation. When several players are in a game together, it becomes natural for two or more to form a coalition in which case the remaining players are encouraged to do the same in order to maximize their gains. If two coalitions emerge, forcing all players to choose one or the other, the game in effect is reduced to a *two-person zero-sum game*. (see: *DECISION THEORY*)

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GENERATIONAL POLITICS (see: *COHORT ANALYSIS*)

GROUP THEORY—an approach that seeks to explain political behavior primarily through the study of the nature and interaction of social groups. Group theorists in political science regard the group as the primary basis for all political activity, and therefore, for political analysis, whereas other investigators view the group as only one of several focal points for the study of political activity. Group theory postulates that the key activities of politics—socialization, communication, pursuit of "interest"—are interactions carried on within or between groups and, therefore, should be identified and studied in that framework.

Small group theory deals with decision-making and other interactive processes in small primary groups usually numbering twenty persons or fewer. Such studies include both formal and informal groups, but special attention is given to the informal relationships that supplement formal group procedures. (see: *group*)

GUTTMAN SCALE—a technique of scaling used to measure attitudes or events that can be ranked with reference to a common characteristic. Attitudes or events are scaled on a continuum so that an affirmative response on any item implies affirmative responses on all other items of lower rank. A scale measuring political instabilty over a 6 month period, for example, might rank items in the following manner: (1) resignation of a cabinet official, (2) demonstrations, (3) assassination, (4) riots or mass arrests, (5) coup, (6) civil war. If the scale is valid, the highest form of instability (6) would likely be preceded by all other forms (1 through 5). On the other hand, if a number of resignations and coups occurred but no demonstrations, assassinations, or riots, the items obviously would not scale. The scale's "coefficient of reproducibility" would be high in the first case and low in the latter. (see: *coefficient of reproducibility, SCALING*)

INSTABILITY EVENT	Jul	Aug	Sept	Oct	Nov	Dec
Resignation of Cabinet official	x			x	x	x
Peaceful demonstrations		x	x	x	x	
Assassination			x			x
Mass arrests or severe riots	x			x	x	x
Coup d'etat					x	
Civil War						x

HIERARCHICAL INFERENCE—a technique for decomposing complex problems into a hierarchical structure and assessing the probabilities of each level of the structure separately beginning with the lowest level (data) and working through intermediate variables to the highest level—the hypotheses. By contrast, in *BAYESIAN ANALYSIS*, experts are asked to assess the likelihood linking data directly to hypotheses. For many problems, however, it is unlikely that one individual has the necessary experience and expertise to relate the lower level data to the upper level hypotheses. By decomposing the problem, it is possible for the specialized knowledge of each expert to be applied in a logically consistent manner.

For example, the hierarchical structure formulated for the hypothetical problem of whether or not Egypt intends to develop a nuclear weapons capability within the next five years might contain four levels. The first level consists of the exhaustive set of hypotheses: (H_1) Egypt does intend to develop nuclear weapons and (H_2) Egypt does not intend to develop nuclear weapons. The second level contains the data (D) and activities (A) which directly impact on the hypotheses. The third level of the hierarchy contains those data and indicators (I) which impact on the hypotheses through the activities described in the second level. The fourth level, logically, contains those data which impact on the hypotheses through indicators in the third level and activities in the second level. Different analysts are consulted for information and judgments at each level of the problem. (see: *BAYESIAN ANALYSIS*)
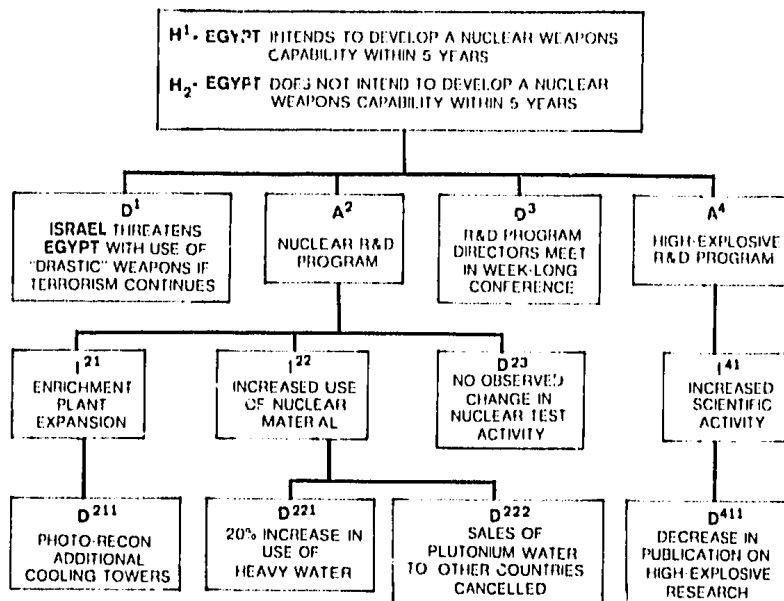
HIERARCHICAL STRUCTURE FOR HYPOTHETICAL NUCLEAR WEAPONS DEVELOPMENT PROGRAM PROBLEM

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INPUT/OUTPUT ANALYSIS—a forecasting technique especially useful for long range economic forecasting. Typically, it is a balance sheet of a national economy: the output of each sector of the economy is either an input into another sector or a consumable. The solution to this system will yield the level of output of each industry which is required to satisfy the total demand for each commodity consumed.

INTEGRATION THEORY—a technique of analysis which seems to explain and measure the amount of "community" or strong cohesiveness among peoples within a political entity or between entities. The three approaches to integration theory are: (1) federalism, (2) functionalism, and (3) communication. The federalists study movements toward or away from international political union. Functionalism studies the structures and functions that govern economic, political and social ties between states. The communications approach examines international transactions in order to explain and measure the degree of cohesiveness between or within states. A relatively new fourth approach, neofunctionalism, focuses on decision-making and the unintended integrative consequences of previous cooperative acts. (see: *STRUCTURAL-FUNCTIONAL ANALYSIS*)

INTERACTION ANALYSIS—the study of activities involving two or more individuals or groups in which the actions of each party serve as stimuli for responses from the other. Such stimulus-response actions may be continuous, constituting a pattern of interaction. Interaction patterns between states are important to the understanding of inter and intra state relations. Typical political interaction patterns involve demands, promises, threats, bargains, coercion, and the responses to these. (see: *transactions, EVENTS ANALYSIS*)

LEGISLATIVE ROLL-CALL ANALYSIS—a broad approach which uses various techniques of quantitative analysis, such as *GUTTMAN SCALING* and *FACTOR ANALYSIS*, to understand, explain, and predict the voting behavior of legislators. Quantitative methods of roll-call analysis describe and measure variations in the voting behavior of individual legislators or groups of legislators and variations among roll calls. Coalitions, parties, blocs, and groups can be identified. Issues of domestic and foreign policy can be compared and contrasted in terms of proponents and opponents, and "clusters" of votes can be discovered that indicate otherwise hidden attitudes and governmental actions.

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LINEAR PROGRAMMING—a mathematical problem-solving technique which selects an optimal solution, subject to one or more constraints. Linear programming is especially useful for determining the optimal mix of resources needed to achieve a desired result under certain limitations, when the number of variables involved prohibits either graphical methods or simple algebraic solutions. Three ingredients are needed: (1) linear variables—that is, ones whose formulas are described by straight lines; (2) constraints, relations among variables, usually expressed in the form of inequalities, which restrict the values certain variables may take; (3) objective function—the rule for maximizing or minimizing which is the target of the analysis. For example, linear programming might be used to help a large company determine how many men, machines, and how much money to allocate to the production of each of its various products. In this case, the linear variables would describe the relationship between, say, labor input and production or between capital and output; the constraints would include the budget and the availability of needed machinery; and the objective function would be profit or market share. Linear programming is the simplest kind of mathematical programming, which is a general name for several mathematical problem solving techniques. "Programming" here is not used in the sense of programming a computer, although computers are often used in solving problems of linear programming. "Programming" here is used in the sense of "planning" for an optimal solution. (see: *MATHEMATICAL PROGRAMMING*)

LONGITUDINAL ANALYSIS (see: *TIME SERIES ANALYSIS*)

MARKOV ANALYSIS (Markov chain)—a sophisticated mathematical technique for predicting the eventual state of affairs in a system, from a knowledge of its current situation and of the probabilities of elementary transitions through a sequence of intermediary states. It does not give period-by-period forecasts, but comes right to a description of the ultimate point the system will reach after passing from state to state. When events are known to be sequential and orderly, a probability diagram or a queuing simulation can be used to trace the probabilities of each alternative path. Markov analysis is used when uncertainty exists about the order of events or when the system may include feedback. For example, the behavior of consumers in switching back and forth between various brands of gasoline might be the subject of a Markov analysis. It would estimate consumer loyalty and fickleness to determine the overall anticipated market shares of the different producers.

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MATHEMATICAL PROGRAMMING—a generic term for several mathematical problem-solving techniques involving resource allocations. The most common method is *LINEAR PROGRAMMING,* in which the variables do not take exponential values (i.e., they may be graphed by straight lines). More esoteric and complex programming variations include non-linear, dynamic, stochastic, parametric, integer, quadratic, and convex programming, each of which applies to specialized cases and objectives.

MONTE CARLO SIMULATION—a statistical technique for synthetic generation of sample data when actual samples are unavailable. Useful when experimentation would be difficult, expensive, or time consuming, Monte Carlo methods generate data by using random numbers and probabilities. It thus provides a way to test a model or simulation with sample values. For example, instead of attempting to predict in advance the probability of different volunteer rates for the armed services, and how these would affect manpower allocation requirements, we could make some assumptions about these rates by using a Monte Carlo simulation. This would supply random numbers, as a check on how well the system could handle these hypothetical values.

MORPHOLOGICAL ANALYSIS—a technique for long range prediction, involving identification of all possible combinations of variables which may comprise the future environment. Illogical or highly unlikely combinations are weeded out, leaving a series of combinations or scenarios describing possible futures. Normally, this exercise is an organizing tool to develop a starting point for further analysis by other methods, especially probability networks. Morphological analysis itself is especially relevant to long range technological prediction of scientific breakthroughs based upon previous discoveries. It also has applications in socio-political and economic forecasting. At its simplest level, morphological analysis is merely organized brainstorming. It could list, for example, a variety of sub-crisis provocations which could involve a region in conflict. It would then seek a complete list of each possible action and counteractions, and consider the various paths of escalation and de-escalation. The most likely of these paths are then selected for more careful consideration.

NATIONAL CHARACTER STUDIES—these draw upon the insights of psychology, cultural anthropology, and sociology to study the effect of national character, or the dominant personality traits of the adult members of a society, upon individual and group political behavior within a state or comparatively, between states. The study of national character was stimulated by the growth of interest in non-Western societies where the impact of social, cultural and psychological variables on political systems could not simply be assumed by the Western observer. (see: *modal personality*)

NETWORK ANALYSIS—a method for depicting the sequence and interrelationship of actions, events, and benchmarks essential for progress toward, and completion of, a significant goal or objective. It provides a means for tying together in reasonable order and sequence, the seemingly infinite mix of variables that will influence an outcome—including decisions, actions, and events. A *network plan* is a blueprint of the mental logic of the analyst which consists of nodes representing events or benchmarks, and arrows representing activities, sequence, and interdependency. In political analysis, the analyst may employ network analysis either retroactively to study the sequence which led to a past event or decision once all the data is collected, or can hypothesize the probable network leading to some future event or decision and plug the data into it as such data is received. This method can also be combined with others, such as *DECISION THEORY* and *CROSS-IMPACT ANALYSIS*.
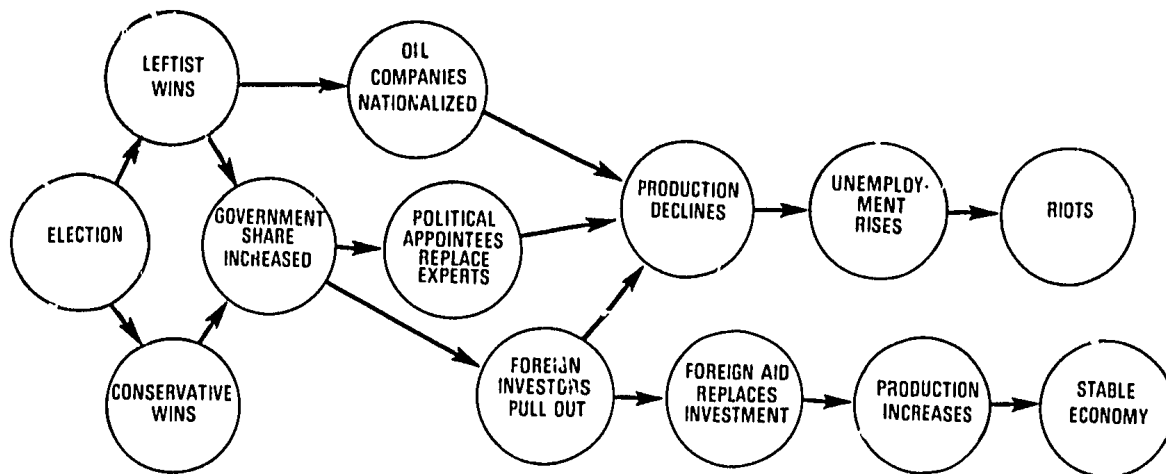
NETWORK ANALYSIS OF POSSIBLE OUTCOMES OF A HYPOTHETICAL ELECTION

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NON-LINEAR PROGRAMMING—a mathematical problem-solving technique which selects optimal solution subject to certain constraints. In *LINEAR PROGRAMMING*, relationships between the variables must be expressed by straight lines. Non-linear programming is designed to cope with the more complex set of problems whose relationships are curvilinear. Although there are general solution techniques for linear programming, not all non-linear programming problems can be solved. (see: *MATHEMATICAL PROGRAMMING*)

OPERATIONS RESEARCH—a generic term encompassing most of the techniques defined in this glossary. Operations research is generally taken to include almost any systematic application of scientific, mathematical, or statistical methods to decision-making problems.

ORGANIZATION THEORY—as applied in political analysis, seeks to explain political systems and events in terms of the nature and functions of the large, complex, goal-oriented groups that make up the political system. Organization theory is concerned with the way organizations seek goals and adapt to their environment, as well as with individual behavior occurring within organizations. An organization theory approach to the study of Soviet military decision-making, for example, would emphasize the routine behavior, goals, and functions of the various significant groups within the Soviet government and military. Some organization theorists have postulated that all organizations behave in essentially the same way, regardless of the society or culture in which they are found, and are therefore essentially predictable. At present there is insufficient evidence to support such a hypothesis. (see: *BUREAUCRATIC POLITICS*)

PANEL STUDY—a technique for comparing the attitudes of an individual over time, as contrasted with survey research techniques which measure the attitudes of groups or aggregates of people at only one point in time. Through interviews of the same people at two or more points in time, the panel study permits the analyst to observe changes in individual attitudes that might be attributable to intervening events. The intervening stimulus for example, might be a public information program conducted between the first and second interviews and planned as part of the study. This kind of study is called an *impact panel*. (see: *SURVEY RESEARCH*)

PARTICIPANT OBSERVATION—a research method by which the investigator becomes a member, or poses as a member, of a group he is studying. As a participant the researcher tries to become familiar with the perspectives and assumptions of group members. As an observer, he tries to view their behavior objectively and eliminate the group's values and biases from his analysis. (see: *GROUP THEORY*)

PATH ANALYSIS—a statistical technique for dealing with a group of interrelated dependent variables (those which the analysis is trying to explain or predict) for which there are several ultimate variables that completely determine them. The ultimate variables may be observed, such as income as a determinant of amount of tax paid, or they may be hypothetical underlying variables—intelligence as a determinant of IQ test scores.
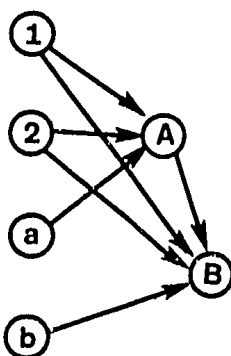
ILLUSTRATION OF A PATH DIAGRAM

For example, unemployment (1) and inflation rate (2) might be observed ultimate variables and popular dissatisfaction (a) and government repression (b) the hypothetical ultimate variables related to the observed dependent variables of riots (A) and political assassination (B). As shown in the graphic above, the ultimate variables (1, 2, a, and b) completely determine the observed variables (A and B), as indicated by the one-headed arrows. Variable B, however, is not only directly dependent on the ultimate variables 1 and 2, but is also indirectly dependent on them through the intermediary of variable A.

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Once the relationships between variables have been identified, path analysis specifies equations which describe these relationships using coefficients that measure the amount of variation in a particular dependent variable that is directly attributable to another variable. The coefficients in equations of path analysis are called *path coefficients*. (see: *CORRELATION, coefficient*)

PERCEPTION ANALYSIS—a mode of decision-making analysis which studies a decision-maker's or group's perceptions—that is, the meaning assigned through the interaction of sensory impressions with beliefs and values. The study of perceptions poses difficult problems of data gathering because sensory impressions, beliefs, and values are internal to each individual and must be inferred from observable behavior. For this reason, perception analysis usually relies upon biographic sketches and *CONTENT ANALYSIS* of speeches, statements and writings to reveal perceptions. Among the factors that affect perception of political phenomena are ideology, personality, past political activity and experience, characteristics of a particular decision stiuation, potential costs and rewards, available information, and the emotional state of the perceiver. (see: *CONTENT ANALYSIS*)

POLICY SCIENCE—an emerging field of inquiry concerned with the application of scientific methods and insights to the improvement of public policy-making and the solution of public problems. *COST BENEFIT ANALYSIS, ENDS-MEANS ANALYSIS,* and *DECISION THEORY* are among the policy science techniques. Policy analysts are particularly concerned with the process by which public policy decisions are made and with clarifying goals, evaluating alternatives, identifying trends, and analyzing the policy situation.

PSYCHO-BIOGRAPHY—a biographical technique which focuses on the personality traits, development, attitudes, and beliefs of the individual under study in order to understand and predict his political behavior. (see: *SOCIAL/PSYCHOLOGICAL APPROACH*)

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PSYCHOLINGUISTICS—the study of language and communication as it relates to the individuals who use the language. Psycholinguists argue that language (everything we know) and speech (behavior expressing what we know) play an intimate, vital, and complex role in human behavior. They use the tools of both psychology and linguistics to study the mental processes underlying the acquisition and use of language. Psycholinguistics can be applied to either the study of an individual leader—what does the use of certain colloquialisms by a particular leader reveal about his personality, for example—or to study the thought processes and behavior of ethnic or national groups--how does the absence of verb tenses in the Chinese language affect Chinese thought processes. Psycholinguists have shown how language governs understanding and comprehension. Several African languages, for example, use the same word for blue and black, and those who speak only these languages cannot differentiate between the two colors until shown the difference.

QUANTIFICATION—the assignment of numerical values to political variables so that they can be measured or compared by quantity. Quantification of any political variable may be achieved, for example, by the judgmental assignment of numbers to the concept being examined or by finding numerical indicators to represent a political variable or concept that cannot be easily quantified. Gross national product, which can be expressed in terms of dollars, for example, can be used as one indicator of national power. (see: *SCALING*)

QUEUE THEORY (waiting line theory)—a systematic study of the various characteristics of the flow of units through some limited service facility, involving congestion and delay. The input to a queueing study would include data on the service system, rates of service, rates of arrival, priorities, feedbacks, etc. Its output would include measurements of the average length of queues, utilization of service facilities, comparisons of different priority ranking systems, effects of multiple servers, bottleneck areas, etc.

REGRESSION—a common statistical technique for predicting a dependent variable—the condition the analyst wishes to explain or predict—from knowledge of its association with independent variables—those variables used to explain changes in the dependent

variable. Simple regression uses one variable to predict one other variable. Multiple regression predicts the dependent variable from a combination of other variables. The regression technique is designed to produce a mathematical formula which describes the relationship between the dependent variable and the independent variable. For example, the number of riots in a city (dependent variable) may be related to the level of unemployment (independent variable). The mechanics of simple regression produce a straight line through the data points which has the "best fit." The criterion for determining "best fit" is known as the least squares criterion which minimizes the sum of the squared vertical distances from each point to the regression line. A correlation coefficient is a measure of how close the points are to the line. A perfect correlation of 1.00 means that each observation lies on the line. The equation which describes the line is called the regression equation and usually takes the general form: $Y = a + b(X)$ where "Y" represents the dependent variable, "X" represents the independent variable, "a" is the point where the line intercepts the vertical axis, and "b" is a constant which measures the impact of X upon Y. The value of b equals the slope of the regression line. (see: *CORRELATION (least squares, slope)*

RICHARDSON MODELING—a predictive method introduced by Lewis F. Richardson's *Arms and Insecurity* which attempts to explain arms races between two nations or groups of nations. Richardson assumed alert interaction between the two, modified by ambition, hostility, fatigue, and cost. He evaluated stability criteria and equilibrium conditions, attempting to predict arms expenditures by each side. This type of interactive model can also be applied to other competitive situations such as retail sales, military intervention, etc.

RISK ANALYSIS—a simulation technique applied to problems of decision making under uncertainty in which the probability distribution of various possible outcomes is estimated. Risk analysis is most effective in comparing alternative policies—it demonstrates which one offers the best chance of high return, and how likely it is. Risk analysis generates the expected values of various courses once the probabilities and outcomes have been supplied.

SCALING—a method of measuring political variables that cannot be counted in natural units. If we are interested in analyzing domestic political instability over a five-year period in Latin America, for example, the events which indicate instability could be valued from O (stable) to 6 (extreme instability) as follows: 0—General election, 1—Resignation of a cabinet official, 2—Peaceful demonstration, 3—Assassination of a significant political figure, 4—Mass arrests or violent riots, 5—Coup d'etat, 6—Civil war. The number of times each event occurred per year would then be multiplied by the value of the event to produce scores which, when added together, would equal the yearly score. The yearly scores could then be plotted on a graph or chart of domestic instability. (see: *GUTTMAN SCALE*)

SCENARIO GENERATION—a narrative description of a sequence of events which illustrates how a future situation might logically evolve. Scenario writing is a representation of possible futures given certain basic initial assumptions. The major emphasis is usually on the subtle points where assumptions may significantly change the projected outcome. The use of scenarios is especially applicable to planning or normative forecasting, as it provides a mechanism for considering the consequences of alternative policies and for sharpening the analyst's thinking about options, generalizations, and probabilities.

SEMANTIC DIFFERENTIAL—a technique for measuring the connotative meaning that people assign to concepts. It consists of several scales ranged between two polar adjectives (good-bad, strong-weak, active-passive, for example) and one or more concepts to be rated on the scales. The semantic differential tool is used in political science for research on political attitudes and beliefs. Voters for example might be asked to rate their attitudes toward political issues or candidates on such scales in order to determine the difference in what those issues and candidates connote to people with different political beliefs. (see: *attitude scaling*)

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SENSITIVITY ANALYSIS—the process of testing a model or simulation in order to determine whether relatively minor changes in the original assumptions cause significant variation in the results. If the output of the system is subject to wide swings in response to small changes of a single variable in the input (i.e., the model is highly sensitive) then the starting data must be specified with great care. If, however, the results are less volatile in following the fluctuations of the input (i.e., low sensitivity) then more error may be permitted and we can still retain confidence in the model's validity.
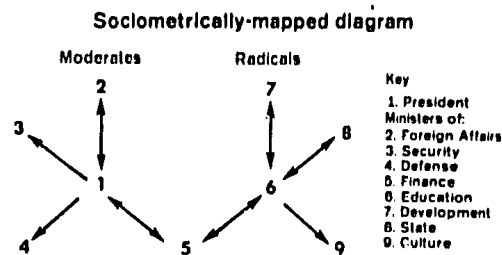
SEQUENTIAL ANALYSIS—the analysis of data derived by a sequential method of sampling in which the members of the sample are drawn one by one or in groups in order, and the results of the drawing at any stage decide whether sampling is to continue. The sample size is not fixed in advance, but depends on the actual results and varies from one sample to another. The sampling terminates according to predetermined rules according to the degree of precision desired. (see: *sample, population, SURVEY RESEARCH*)

SIMPLEX METHOD—a computational linear programming technique designed for solving problems which contain many variables or constraints. In such complex problems, graphic techniques are inadequate and manual computation is too time consuming. The simplex method avoids searching through all possible alternatives in a trial-and-error approach, by using an acceptable solution as a criterion for testing the optimal solution.

SIMULATION—the reproduction, in a laboratory or experimental situation, of selected aspects of a real or hypothetical system. Political simulations are usually simplified or scaled-down representations of political behavior, such as decision-making. Some simulations involve only human interaction; others may be done by computer; and some combine both features. Computer simulation requires complete specification of the relevant variables and decision rules. With human participants, at least some of the rules governing the interplay of model components are left unspecified. If only human participants are involved, the technique is usually called gaming.

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SOCIAL/PSYCHOLOGICAL APPROACH—a mode of analysis which focuses upon human personality and behavior as a political determinant. The general approach encompasses a variety of techniques and methods including *PSYCHO-BIOGRAPHY, CONFLICT BEHAVIOR ANALYSIS, NATIONAL CHARACTER* and modal personality studies, psychoanalysis, *DECISION-MAKING, CROSS-CULTURAL,* and *ELITE ANALYSIS.*

SOCIOMETRY—a technique for the analysis of relationships within small groups. Sociometry uses data from questionnaires, interviews, or expert opinion to determine which persons most associate in a given activity with other persons of the group. Patterns of interaction between group members—such as power relationships and personal and ideological preferences—are revealed. Diagramming the power relationships between the members of a cabinet that is divided between radicals and moderates, for example, reveals the pivotal position of the Finance Minister. Mere rank order listing of the government's leaders by degree of political power often conceals the importance of the individual as well as much information about relationships between individuals. The graphic representation of this information by means of circles, connecting lines, or other geometric figures, is called a *sociogram.* (see: *attitude scaling, sociogram*)

Sociometrically-mapped diagram

Moderates   Radicals

Key
1. President
Ministers of:
2. Foreign Affairs
3. Security
4. Defense
5. Finance
6. Education
7. Development
8. State
9. Culture

STIMULUS-RESPONSE ANALYSIS—(see: *INTERACTION ANALYSIS*)

STRUCTURAL-FUNCTIONAL ANALYSIS—political analysis that focuses on the functions performed within a political system and the structures through which they are performed. A *function,* this context, is the result or consequence of actions which satisfy the needs or demands of the system for its perpetuation. A *structure* is any pattern which governs actions, including some concrete organizational structures as politic 1 parties, legislatures, or juntas. Structural-functional analysis post... ...s that certain necessary functions must be performed if a system is to persist. It provides a framework for analyzing systems, stressing the interrelationships between structures and functions within a given system. One of the most influential applications of structural-functional analysis to

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political science was by Gabriel Almond who provided a model of five political or input functions—political socialization, political recruitment, interest articulation, interest aggregation, and political communication— and three governmental or output functions—rule making, rule application, and rule adjudication. (see: *FUNCTIONALISM*)

SUBSTITUTION ANALYSIS—a technique for technological forecasting which measures the percentage of a given market that has been or will be assumed by a new technological innovation. Typically, the data is represented as a substitution curve over time, and when the new process has reached a level of 15 percent of the market, the trend is considered irreversible. Extrapolation to the future is then possible. For example, in forecasting a country's shift to certain high performance weapons, we measure the trends in the percentage of the total "market" already captured by the new HPW's and project forward.

SURVEY RESEARCH—the investigation of social phenomena by means of interviews and questionnaires administered to a number of respondents for the purpose of studying people's attitudes, opinions, behavior, and social attributes (such as age, sex, political affiliation, and economic class) and the relationships among these characteristics. Survey research ordinarily entails the study of samples, from which inferences may be drawn about the whole population under investigation, and provides data on the characteristics of each individual interviewed. This contrasts with *aggregate data,* such as trade or census statistics, which summarize the characteristics or transactions of a whole population. (see: *sample, population, aggregate data*)

SYSTEMS ANALYSIS—in political analysis, a method of analyzing politics as a set of interactions occurring within, but analytically distinct from, the larger social environment. A *system,* in this context, is a pattern of interactions or persisting relationships among political entities. A system that constitutes an element of a larger system is called a *subsystem*—for example the legislature within a government, or the committee structure within a legislature. The setting within which a system occurs is its *environment.* Political analysts have directed systems analysis to such questions as the relationships of political systems to their social and economic environment, the persistence of systems over time, system stability, system functions and related structures (the concern primarily of *STRUCTURAL-FUNCTIONAL ANALYSIS*), the identification, classification, and measurement of system inputs and outputs, and communication within a political system *(COMMUNICATIONS THEORY).*

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In an organizational-management context, systems analysis refers to the use of a systems framework to evaluate strategies, alternatives, and program objectives with the object of using resources most effectively and achieving goals. It provides decision-makers with a full, accurate and meaningful summary of the information relevant to any decision, by charting, describing, and reducing to mathematical language any enterprise, organization, or issue. The newly constructed "system" is then operated by feeding in hypothetical data; by changing policies or circumstances and revising the equations to fit the new assumptions. Further simulation produces another set of results, and successive "runs" of the process are then compared to attain the optimum configuration of elements.

SYSTEMS DYNAMICS—a general name for a variety of modeling approaches to long range forecasting based upon estimation of the levels and rates of change of key variables. Systems dynamics does not necessitate as sharp a degree of precision in the original assumptions as do other modeling methods.

TECHNOLOGY ASSESSMENT—the systematic study of a new technology on a society with special emphasis on impacts that are unintended, indirect, and delayed. Essentially the steps are to define the scope of inquiry, outline the state of the art in the technology being assessed (as well as in related technologies), develop state-of-society assumptions regarding non-technological factors, identify impact areas (law, medicine, and social relationships, for example), and identify and analyze the options open to the society.

TIME SERIES ANALYSIS—a general name for a number of processes using past experience alone to predict future values of a variable which fluctuates over time. The result is a predictive formula which best fits the observed data. It can represent trends, cycles, seasonal variations, etc. The most sophisticated time series analyses are similar to a *REGRESSION* equation in which the dependent variable is the prediction, and the independent variables are the past values the variable itself has previously taken. The predictive ability of the equation can be tested on either past or new data. For example, enemy infiltration into a country may

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have a general upward trend, modified by seasonal cycles due to weather. Additionally, the rates will be affected by policy choices on both sides, and there may be a simple random component. Time series analysis would attempt to sort out all the different elements and provide a predictive formula.

Diachronic analysis and longitudinal analysis are other names applied to studies having a time dimension. Research dealing with data drawn from a single time period, or examined without reference to time as a variable, is called *synchronic* or *cross-sectional* analysis.

TRANSACTION ANALYSIS—(see: *EVENTS ANALYSIS*)

VOTING BEHAVIOR STUDIES—(see: *ELECTION ANALYSIS*)

WAR GAMING—a simulation of a military battle consisting of two opposing forces with a referee or control team. The control team evaluates the impact and outcome of the decisions of each side and writes the scenario for successive plays. The game may be actually played out on a field, or programmed and run by computer. By repetition and experimentation, this type of simulation may be used to "optimize" military resource allocations, select strategies, and test innovations.

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