11.B. Philosophical and Methodological Foundations of Delphi

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It takes two of us to create a truth,
one to utter it and one to understand it.
—Kahlil Gibran

Introduction

The purpose of this article is to show that underlying any scientific technique, theory, or hypothesis there is always some philosophical basis or theory about the nature of the world upon which that technique, theory, or hypothesis fundamentally rests or depends. We also wish to show that there is more than one fundamental basis which can underlie any technique, or in other words, that there is no one "best" or even "unique" philosophical basis which underlies any scientific procedure or theory. Depending upon the basis which is presumed, there results a radically different developmental and application history of a technique. Thus in this sense, the particular basis upon which a scientific procedure depends is of fundamental practical importance and not just of philosophical interest.

We human beings seem to have a basic talent for disguising through phraseology the fundamental similarities that exist between common methodologies of a different name. As a result, we often bicker and quarrel about such superficial matters as whether this or that name is appropriate for a certain technique when the real issue is whether the philosophical basis or system of inquiry that underlies a proposed technique or methodology is sound and appropriate. We are indeed the prisoners of our basic images of reality. Not only are we generally unaware of the different philosophical images that underlie our various technical models, but each of us has a fundamental image of reality that runs so deep that often we are the last to know that we hold it. As a result we disagree with our fellow man and we experience inner conflict without really knowing why. What's worse, we ensure this ignorance and conflict by hiding behind catchwords and fancy names for techniques. The field of endeavor subsumed under the name of Delphi is no less remiss in this respect than many other disciplines. Its characteristic vocabulary more often obscures the issues than illuminates them.

One of the basic purposes of our discussion is to bring these fundamental differences and conflicts of methodology up to the surface for conscious examination so that, one hopes, we can be in a better position to choose explicitly the approach we wish to adopt. In order to accomplish this we consider a number of fundamental historical stances that men have taken toward the problem of establishing the "truth content" of a system of communication signals or acts. More precisely, the purpose of this article is to examine the variety of ways and mechanisms in which men have chosen to locate the criteria which would supposedly "guarantee" our "true and accurate understanding" of the "content" of a communication act or acts. We will also show that every one of these fundamental ways differs sharply from the others and that each of them has major strengths as well as major weaknesses. The moral of this discussion will be that there is *no one "single best jay"* for ensuring our understanding of the content of a set of communication acts or for ascribing validity to a communication. The reason is that there is no one mode of ensuring understanding or for prescribing the validity of a communication that possesses all of the desired characteristics that one would like any preferred mode to possess. As we wish to illustrate, this awareness itself constitutes a kind of strength. To show that there is no one mode that can satisfy our every requirement, i.e., that there is no one mode that is *best* in all senses and for all circumstances, is not to say that each of these modes does not appear to be "better suited" for some special set of circumstances.

Since these various modes or characteristic models for ensuring validity basically derive from the history of Western philosophy, another objective of this article is also to show what philosophy and, especially, what the philosophy of science specifically and concretely has to offer the field of Delphi design. For example, one of the things we wish to show is which among these various philosophical modes have been utilized to date (and how) and which have been neglected. When there has been little or no utilization of a particular philosophical basis then we may infer existing gaps in the development of the Delphi to date.

Before we describe each of these philosophical modes or systems more fully, we can rather easily and simply convey the general spirit of each of them by means of the following exercise. Suppose we are given a set of statements or propositions by some individual or group which pretend to describe some alleged "truth." Then each of our philosophical systems (hereafter referred to as an Inquiring System, or IS) can be simply differentiated from one another in terms of the kind of characteristic question(s) that each would address either to the statement itself or to the individual (group) making the statement or assertion. Each question in effect embodies the major philosophical criterion that would have to be met before that Inquiring System would accept the propositions as valid or as true.

The Leibnizian analyst or IS would ask something like:

> How can one independently of any empirical or personal considerations give a purely rational justification of the proposed proposition or assertion? Can one build or demonstrate a rational model which underlies the proposition or assertion? How was the result deduced; is it precise, certain?

The Lockean analyst or IS would ask something like:

> Since for me data are always prior to the development of formal theory, how can one independently of any formal model justify the assertion by means of some objective data or the consensus of some group of expert judges that bears on the subject matter of the assertions? What are the supporting "statistics"? What is the "probability" that

> one is right? Are the assertions a good "estimate" of the true empirical state of affairs?

The Kantian analyst or IS would ask something like:

> Since data and theory (models) always exist side by side, does there exist *some combination* of *data* or expert judgment plus underlying *theoretical justification* for the data that would justify the propositions? What *alternative* sets of propositions exist and which best satisfy my objectives and offer the strongest combination of data plus model?

The Hegelian (Dialectical) analyst or IS would ask something like:

> Since every set of propositions is a reflection of a more general theory or plan about the nature of the world as a *whole system, i.e., a world-view,* does there exist some alternate sharply differing world-view that would permit the serious consideration of a completely opposite set of propositions? Why is this opposing view not true or more desirable? Further, does this conflict between the plan and the counterplan allow a third plan or world-view to emerge that is a *creative synthesis* of the original plan and counterplan?

Finally, the Singerian analyst or IS would ask:

> Have we taken a broad enough perspective of the basic problem? Have we from the very beginning asked the right question? Have we focused on the right objectives? To what extent are the questions and models of each inquirer a reflection of the unique *personality* of each inquirer as much as they are felt to be a "natural" characteristic or property of the "real" world?"

Even at this point in the discussion, it should be apparent that as a body these are very different kinds of questions and that each of them is indicative of a fundamentally different way of ascribing content to a communication. It should also he apparent, and it should really go without saying, that these do not exhaust the universe of potential questions. There are many more philosophical positions and approaches to "validity" than we could possibly hope to deal with in this article. These positions do represent, however, some of the most significant basic approaches and, in a sense, pure-modes from which others can be constructed.

The plan of the rest of this article is briefly as follows: first, we shall describe each inquirer in turn and in general terms, but we hope in enough detail to give the reader more of a feel for each system; second, along with the description of each inquirer, we shall attempt to point out the influence or lack of influence each philosophy of inquiry has had on the Delphi technique; and third, we shall attempt to point out some general conclusions regarding the nature and future of the Delphi technique as a result of this analysis.

It should be borne in mind as we proceed that the question of concern is not how we can determine or agree on the meaning of "truth" with "perfect or complete certainty," for put in this form, the answer is clearly that we cannot know anything with "perfect certainty." We cannot even know with "perfect certainty" that "we cannot know anything with `perfect certainty.'" The real question is what can we know and, even more to the point, how we can justify what we think we can know. It is on this very issue that the difference between the various Inquiring Systems arises and the utility or value of the Delphi technique depends.

Inquiring Systems (IS)

The process of inquiry, whether it be for a single individual or a group of individuals, may be "represented" by a very general system. We start with some *assumed* "external event" or "raw data set" which for the moment we consider to be a characteristic property of the "real world," i.e., we assume the data set "exists" in the "external world." (As we shall see in a moment, this amounts to assuming a Lockean IS beginning. The point is that we can't even begin to describe the "world" and our "knowledge" of "it" without having to invoke some "conceptualization," i.e., some Inquiring System characterization, of "it.") Next we apply some transformation and/or filter to the "raw data" in order to get it into the "right form" for input to some model. The model, which may be any sort of structured process, is represented by a set of rules which may be either in the form of an algorithm or a set of heuristic principles. The model acts on the input to transform it from the state of "input data" to the state of "output information." This output information may in turn be passed through another filter or transform to put it in the right form so that a decisionmaker can recognize and utilize it as "information" or as a "policy recommendation." In terms of this general configuration, the various IS can be differentiated from one another with respect to (1) the priority assigned to the various systems components, i.e., which components are regarded as more important or fundamental by one IS than by another, and (2) the degree of interdependence assigned to the various systems components by each IS.

Our objective in the following discussion will be to draw a sufficient distinction between the philosophical Inquirying System (IS) concepts so that we can place alternative Delphi design methodologies into this perspective.

Lockean IS

As first pioneered by Dalkey, Helmer, and Rescher at Rand, the Delphi technique represents a prime example of Lockean inquiry. Indeed, one would be hard pressed to find a better contemporary example of a Lockean inquirer than the Delphi.

The philosophical mood underlying the major part of *empirical science is* that of Locke. The sense of Lockean IS can be rather quickly and generally grasped in terms of the following characteristics:

(1) Truth is *experiential, i.e.,* the truth content of a system (or communication) is associated *entirely* with its empirical content. A model of a system is an *empirical model* and the truth of the model is measured in terms of our ability (a) to reduce every complex proposition down to its simple empirical referents (i.e., simple observations)

and (b) to ensure the validity of each of the simple referents by means of the widespread, freely obtained *agreement* between different human observers.

(2) A corollary to (1) is that the truth of the model does not rest upon any theoretical considerations, i.e., upon the prior assumption of any theory (this is the equivalent of Locke's *tabula rasa).* Lockean inquirers are opposed to the prior presumption of theory, since in their view this exactly reverses the justifiable order of things. Data are that which are prior to and justify theory, not the other way around. The only general propositions which are accepted are those which can be justified through "direct observation" or have already been so justified previously. In sum, *the data input sector is* not only *prior to the formal model or theory sector but it is separate from it as well. The whole of the Lockean IS is built up from the data input sector.*

In brief, Lockean IS are the epitome of *experimental, consensual* systems. On any problem, they will build an empirical, inductive representation of it. They start from a set of elementary empirical judgments ("raw data," observations, sensations) and from these build up a network of ever expanding, increasingly more general networks of factual propositions. Where in the Leibnizian IS to be discussed shortly the networks are theoretically, deductively derived, in a Lockean IS they are empirically, inductively derived. The guarantor of such systems has traditionally been the function of human agreement, i.e., an empirical generalization (or communication) is judged "objective," "true," or "factual" if there is "sufficient widespread agreement" on it by a group of "experts." The final information content of a Lockean IS is identified almost exclusively with its empirical content.

A prime methodological example of Lockean thinking can be found in the field of statistics. Although statistics is heavily Leibnizian in the sense that it devotes a considerable proportion o£ its energies to the formal treatment of data and to the the development of formal statistical models, there is a strong if not almost pure Lockean component as well. The pure Lockean component manifests itself in the attitude that although statistical methods may "transform" the "basic raw data" and "represent" "it" differently, statistical methods themselves are presumed not to create the "basic raw data." In this sense, the "raw data" are presumed to be *prior to* and *independent of* the formal (theoretical) statistical treatment of the data. The "raw data" are granted a prior existential status. Another way to put this is to say that there is little or no match between the theory that the observer of the raw data has actually used (and has had to use) in order to collect his "raw data" in the first place and the theory (statistics) he has used to analyze it in the second place A typical Lockean point of view is the assertion that one doesn't need any theory in order to collect data first, only to analyze it subsequently.

As mentioned at the beginning of this section, the Delphi, at least as it was originally developed, is a classic example of a Lockean inquirer. Furthermore, *the Lockean basis of Delphi still remains the prime philosophical basis of the technique to date.*

As defined earlier Delphi is a procedure for structuring a communication process among a large group of individuals. In assessing the potential development of, say, a technical area, a large group (typically in the tens or hundreds) are asked to "vote" on when they think certain events will occur. One of the major premises underlying the whole approach is the assumption that a large number of "expert" judgments is required in order to "treat adequately" any issue. As a result, a face-to-face exchange among the group members would be inefficient or impossible because of the cost and time that would be involved in bringing all the parties together. The procedure is about as pure and perfect a Lockean procedure as one could ever hope to find because, first, the "raw data inputs" are the opinions or judgments of the experts; second, *the validity of the resulting judgment of the entire group is typically measured in terms of the explicit "degree of consensus" among the experts.* What distinguishes the Delphi from an ordinary polling procedure is the feedback of the information gathered from the group and the opportunity of the individuals to modify or refine their judgments based upon their reaction to the collective views of the group. Secondary characteristics are various degrees of anonymity imposed on the individual and collective responses to avoid undesirable psychological effects.

The problems associated with Delphi illustrate the problems associated with Lockean inquiry in general. The judgments that typically survive a Delphi procedure may not be the "best" judgments but, rather, the compromise position. As a result, the surviving judgments may lack the significance that extreme or conflicting positions may possess.

The strength of Lockean IS lies in their ability to sweep in rich sources of experiential data. In general, the sources are so rich that they literally overwhelm the current analytical capabilities of most Leibnizian (analytical) systems. The weaknesses, on the other hand, are those that beset all empirical systems. While experience is undoubtedly rich, it can also be extremely fallible and misleading. Further, the "raw data," "facts," or "simple observables" of the empiricist have *always* on deeper scientific and philosophical analysis proved to be exceedingly complex and hence further divisible into other entities themselves thought to be indivisible or simple, ad infinitum, More troublesome still is the almost extreme and unreflective reliance on agreement as the sole or major principle for producing information and even truth out of raw data. The trouble with agreement is that its costs can become too prohibitive and agreement itself can become too imposing. It is not that agreement has nothing to recommend it. It is just that agreement is merely one of the many philosophical ways for producing "truth" out of experiential data. The danger with agreement is that it may stifle conflict and debate when they are needed most. As a result, Lockean IS are best suited for working on well-structured problem situations for which there exists a *strong consensual* position on "the nature of the problem situation." If these conditions or assumptions cannot be met or justified by the decisionmaker-for example, if it seems too risky to base projections of what, say, the future will be like on the judgments of expertsthen no matter how strong the agreement between them is, some alternate system of inquiry may be called for.

While the consensus-oriented Delphi may be appropriate to technological forecasting it may be somewhat inappropriate for such things as technology assessment, objective or policy formulation, strategic planning, and resource allocation analyses. These latter applications of Delphi often or should involve the necessity to explore or generate *alternatives,* which is very different from the generation of consensus.

Leibnizian IS

The philosophical mood underlying the major part of theoretical science is that of Leibniz. The sense of Leibnizian inquiry can be rather quickly and generally captured in terms of the following characteristics:

(1) Truth is *analytic; i.e.,* the truth content of a system is associated *entirely* with its formal content. A model of a system is a formal model and the truth of the model is measured in terms of *its* ability to offer a theoretical explanation of a wide range of general phenomena and in terms of *our* ability as modelbuilders to state clearly the formal conditions under which the model holds.

(2) A corollary to (1) is that the truth of the model does not rest upon *any external considerations, i.e., upon* the raw data of the external world. Leibnizian inquirers regard empirical data as an inherently risky base upon which to found universal conclusions of any kind, since from a finite data set one is never justified in inferring any general proposition. The only general propositions which are accepted are those that can be justified through purely rational models and/or arguments. Through a series of similar arguments, *Leibnizian IS not only regard the formal model component as separate from the data input component but prior to it as well.* Another way to put this is to say that *the whole of the Leibnizian IS is contained in the formal sector and thus it has priority over all the other components.*

In short, Leibnizian IS are the epitome of formal, symbolic systems. For *any* problem, they will characteristically strive to reduce it to a formal mathematical or symbolic representation. They start from a set of elementary, primitive "formal truths" and from these build up a network of ever expanding, increasingly more general, formal propositional truths. The *guarantor of* such systems has traditionally been the precise specification of what shall count as a proof for a derived theorem or proposition; other guarantor notions are those of internal consistency, completeness, comprehensiveness, etc. The final information content of Leibnizian IS is identified almost exclusively with its symbolic content.

A prime example of Leibnizian inquiry is the field of Operations Research (OR) in the sense that the major energies of the profession have been almost exclusively directed toward the construction and exploration of highly sophisticated formal models. OR is a prime example of Leibnizian inquiry not because there is no utilization of external data whatsoever in OR models but because in the training of Operations Researchers significantly more attention is paid to teaching students how to build sophisticated models than in teaching them equally sophisticated methods of data collection and analyses. There is the implication that the two activities are separable, i.e., that data can be collected independently of formal methods of analysis.

Delphi by itself is not a Leibnizian inquirer and is better viewed from the perspective of some of the alternative Inquiring Systems. However, many of the views and assertions made with respect to the Delphi technique involve Leibnizian arguments. Delphi has, for example, been accused of being very "unscientific." When assertions of this type are examined one usually finds the underlying proposition rests on equating what is "scientific" to what is "I,eibnizian." This is a common misconception that has also affected other endeavors in the social, or so-called soft, sciences where it is felt that the development of a discipline into a science must follow some preordained path leading to the situation where all the results of the discipline can be expressed in Leibnizian "laws." We have today in such areas as economics, sociology, etc., schools of research dedicated to the construction of formal models as ends in themselves.

In Delphi we find a similar phenomenon taking place where models are constructed for the purpose of describing the Delphi process and for determining *the* "truth" content of a given Delphi. (See, for example, the articles in Chapter IV.) One model hypothesizes that the truth content of a Delphi result (often measured as the error) increases as the size of the Delphi group increases. This concept is often used to guide the choice of the size of the participant group in a Delphi. Other formal models have been proposed to measure an individual's "expertise" as a function of the quantity of information supplied and the length of associated questions. All such models, which are *independent of the content* of what is being communicated but look for structured relationships in the process of the communication, are attempts to ascribe Leibnizian properties to the Delphi process. The existence of such models in certain circumstances do not in themselves make the Delphi technique any more or less "scientific." They are certainly useful in furthering our understanding of the technique and should be encouraged. However, they are based upon assumptions, such as the superiority of theory over data and the general applicability of formal methods of reasoning, which are quite suspect with respect to the scope of application of the Delphi technique and the relative experimental bases upon which most of these models currently rest. The utility of Delphi, at least in the near future, does not appear to rest upon making Delphi appear or be more Leibnizian but, rather, in the recognition of what all the IS models can contribute to the development of the Delphi methodology. Our current understanding of human thought and decision processes is probably still too rudimentary to expect generally valid formal models of the Delphi process at this time.

For which kinds of problem situations are Lcibnizian analyses most appropriate? First of all, the situations must be sufficiently "well understood" and "simple enough" so that they can be modeled. Thus, Leibnizian IS are best suited for working on clearly definable (i.e., well-structured) problems for which there exists an analytic formulation as well as solution. Second, the modeler must have strong reasons for believing in the assumptions which underlie Leibnizian inquiry, e.g., that the model is universally and continually applicable. In a basic sense, the fundamental guarantor of Leibnizian inquiry is the "understanding" of the model-builder; i.e., he must have enough faith in his understanding of the situation to believe he has "accurately" and "faithfully" represented it.

Note that there is no sure way to prove or justify the assumptions underlying Leibnizian inquiry. The same is true of all the other IS. But then this is not the point. The point is to show the kinds of assumptions we are required to make if we wish to employ Lcibnizian inquiry so that if the decisionmaker or modeler is unwilling to live with these assumptions he will know that another IS may possibly be called for.

Kantian IS

The preceding two sections illustrate the difficulties that arise from emphasizing one of the components of a tightly coupled system of inquiry to the detriment of other components. Leibnizian inquiry emphasizes theory to the detriment of data. Lockean inquiry emphasizes data to the detriment of theory. When these attitudes are translated into professional practice, what often results is the development of highly sophisticated models with little or no concern for the difficult problems associated with the collection of data or the seemingly endless proliferation of data with little regard for the dictates of currently existing models.

The recent controversy surrounding the attempts of Forrester and Meadows[1] to build a "World Model" is a good illustration of the strong differences between these two points of view. In our opinion, the work of Forrester and Meadows represents an almost pure Leibnizian approach to the modeling of large, complicated systems. The Forrester and Meadows model is, in effect, data independent. One can criticize the model on pure Leibnizian grounds, e.g., whether the internal theory and structure of the model are sound with respect to current economic and social theory, and some of the critics have chosen to do this. However, it would seem to us that more often than not the critics have chosen to offer a Lockean critique, i.e., that some other way, say using accurate statistical data, is a better way to build a sound forecast model of the world. While this is a legitimate method of criticism, to a large extent it only further exacerbates the differences between the two approaches and hence misses the real point. To us the real point is not whether the ForresterMeadows approach is *the* correct Leibnizian approach, or whether there is a correct Lockean approach, but rather, whether any Leibnizian or Lockean approach acting independently of the other could ever possibly be "correct." Forrester and Meadows seek to justify (guarantee?) their approach through the robustness and richness of their *model,* and their Lockean critics attempt to establish the validity of their approach through the priority and "regularity" of the statistical data to which they appeal. Perhaps if the debate proves anything, it raises the serious question as to whether an advanced modern society can continue to rely on purely Leibnizian or Lockean efforts for its planning. In order to evaluate the relative merits of separate Leibnizian or Lockean inquirers, it is necessary to go to a competing philosophy which incorporates both, such as the Kantian inquirer.

The sense of Kantian inquiry can be rather quickly grasped through the following set of general characteristics:

(1) Truth is *synthetic; i.e.,* the truth content of a system is not located in either its theoretical or its empirical components, but in *both. A* model of a system is a synthetic model in the sense that the truth of the model is measured in terms of the model's ability (a) to associate every theoretical term of the model with some empirical referent

[1] Meadows, Dennis "Limits to Growth" 1972 Universe Books.

and (b) to show that (how) underlying the collection of every empirical observation related to the phenomenon under investigation there is an associated theoretical referent.

(2) A corollary to (1) is that neither the data input sector nor the theory sector have priority over one another. Theories or general propositions are built up from data, and in this sense theories are dependent on data, but data cannot be collected without the prior presumption of some theory of data collection (i.e., a theory of "how to make observations," "what to observe," etc.), and in this sense data are dependent on theories. Theory *and data are inseparable.* In other words,' Kantian IS require some coordinated image or plan of the system as a whole before any sector of the system can be worked on or function properly.

These hardly begin to exhaust all the features we identify with Kantian inquiry. A more complete description would read as follows: Kantian IS are the epitome of multimodel, synthetic systems. On any problem, they will build at least two alternate representations or models of it. (If the alternate representations are complementary, we have a Kantian IS; if they are antithetical, we have a Hegelian IS, as described in the next section.) The representations are partly Leibnizian and partly Lockean; i.e., Kantian IS make explicit the strong interaction between scientific theory and data. They show that in order to collect some scientific data on a problem a posteriori one *always* has had to presuppose the existence of some scientific theory a priori, no matter how implicit and informal that theory may be. Kantian IS presuppose at least two alternate scientific theories (this is their Leibnizian component) on any problem or phenomenon. From these alternate Leibnizian bases, they then build up at least two alternate Lockean fact nets. The hope is that out of these alternate fact nets, or representations of a decisionmaker's or client's problem, there will be one that is "best" for representing his problem. The defect of Leibnizian and Lockean IS is that they tend to give only one explicit view of a problem situation. Kantian IS attempt to give *many* explicit views. The guarantor of such systems is the degree of fit or match between the underlying theory (theoretical predictions) and the data collected under the presumption of that theory plus the "deeper insight" and "greater confidence" a decisionmaker feels he has as a result of witnessing many different views of his problem.

The reason Kantian IS place such a heavy emphasis on alternate models is that in dealing with problems like planning for the future, the real concern is how to get as many perspectives on the nature of the problem as possible. Problems which involve the future cannot be formulated and solved in the same way that one solves problems in arithmetic, i.e., via a single, wellstructured approach. There seems to be something fundamentally different about the class to which planning problems belong. In dealing with the future, we are not dealing with the concrete realities of human existence, but, if only in part, with the hopes, the dreams, the plans, and the aspirations of men. Since different men rarely share the same aspirations, it seems that the best way to "analyze" aspirations is to compare as many of them against one another as we can. If the future is 99 percent aspiration or plan, it would seem that the best way to get a handle on the future is *to draw forth explicitly as many different aspirations or plans for the future as possible.* In short, we want to examine as many different alternate futures as we can.

In the field of planning, Normative Forecasting, Planning Programming Budgeting Systems (PPBS), and Cost-Effectiveness or Cost-Benefit Analyses are all examples of Kantian inquiry, although these are such low-level Kantian inquirers as to be almost more Leibnizian in nature than Kantian. The Kantian element that these various approaches share is the fact that they are all concerned with *alternate paths*, or *methods*, *of* getting from a present state to a future state characterized by certain objectives, needs, or goals. When these various planning vehicles have failed, it is not just because we are dealing with an inherently fuzzy problem-indeed that is the basic nature of the problembut because we have failed to produce alternatives that are true alternatives and to show that the data, models, and objectives cannot be separated for purposes of planning.

In recent years, there have been a number of Delphi studies which in contrast to the original Lockean-based consensus Delphis begin "to take on" more actively the characteristics of Kantian inquiry. The initial Delphis were characterized by a strong emphasis on the use of consensus by a group of "experts" as *the* means to converge on a single model or position on some issue. In contrast, the explicit purpose of a Kantian Delphi is to elicit alternatives so that a comprehensive overview of the issue can take place. In terms of communication processes, while a "consensus," or Lockean, Delphi is better suited to setting up a communication structure among an already informed group that possesses the same general core of knowledge, a Kantian, or "contributory," Delphi attempts to design a structure which allows many "informed" individuals in different disciplines or specialties to contribute information or judgments to a problem area which is much broader in scope than the knowledge that any one of the individuals possesses. This type of Delphi has been applied to the conceptualization of such problems as: (1) the definition of a structural model for material flows in the steel industry (see Chapter III, C, 3); (2) the examination of the current and the potential role of the mentally retarded in society (see Chapter VI, D); (3) the forecasting of the future characteristics of recreation and leisure (see Chapter VI, D); and (4) the examination of the past history of the internal combustion engine[2] for a clue to significant events possibly affecting its future. While all of these Delphis had specific forecasting objectives, none of them could be achieved if all the parties to the Delphi were drawn from the same specialized interest group. The problems were broader than that which could be encompassed by any single discipline or mode of thinking. For example, the examination of the role of the mentally retarded in our society is neither the exclusive problem nor the sole province of any special group. Educators, psychiatrists, parents, and teachers all have different and valid perspectives to contribute to the definition of the "problem." Consensus on a single definition is not the goal, at least not in the initial stages, but rather, the eliciting of many diverse points of view and potential aspects of the problem. In essence, the objective is establishing how to fit the pieces of a jigsaw puzzle together, and even determining if it is one or many puzzles.

The problem of conceptualizing goals and objectives is not an explicit part of the three inquiry processes we have discussed so far. That is, the Leibnizian and Lockean IS are not explicitly goal directed. For example, Leibnizian IS assume that the same

[2] proprietary Delphi in 1969 by Kenneth Craver of Monsanto Company.

rational model is applicable no matter what the problem and the objectives of the decisionmaker or who it is that has the problem. In contrast, the Kantian IS is explicitly goal oriented, i.e., it hopes by presenting a decisionmaker with several alternative models of his problem to better clarify both the problem and the nature of the objectives, which after all are part of the "problem."

Kantian inquiry is best suited to problems which are inherently illstructured, i.e., the kinds of problems which are inherently difficult to formu late in pure Leibnizian or Lockean terms because the nature of the problem does not admit of a clear consensus or a simple analytic attack. On the other hand, the Kantian inquiry is not especially suited for the kinds of problems which admit of a single clear-cut formulation because here the proliferation of alternate models may not only be costly but time consuming as well. Kantian inquiry may also overwhelm those who are used to "the single best model" approach to any problem. Of course this in itself is not necessarily bad if it helps to teach those who hold this belief that there are some kinds of problems for which there is no one best approach. Social problems inherently seem to be of this kind and thus to call for Kantian approach. The concept of "technology assessment" as a vehicle for determining the relationships between technology and social consequences would also seem to imply the necessity of at least a Kantian approach. Many efforts which fall under the heading of "assessments" have proved to be inadequate because they were conducted on pure Leibnizian or Lockean bases.

Hegelian, or Dialectical, IS

The idea of the Hegelian, or Dialectical, IS can be conveyed as follows:

(1) Truth is *conflictual; i.e.,* the truth content of a system is the result of a highly complicated process which depends on the existence of a plan and a *diametrically opposed counterplan.* The plan and the counterplan represent strongly divergent and opposing conceptions of the whole system. The function of the plan and the counterplan is to engage each other in an unremitting debate over the "true" nature of the whole system, in order to draw forth a new plan that will, one hopes, reconcile (synthesize, encompass) the plan and the counterplan.

(2) A corollary to (1) is that by itself the data inlnit sector is totally meaningless and only becomes meaningful, i.e., "information," by being coupled to the plan and the counterplan. Further, it is postulated that there is a particular input data set which can be shown to be consistent with both the plan and the counterplan; i.e., by itself this data set supports neither naturally, but there is an interpretation of the data such that it is consistent with both the plan and the counterplan, It is also postulated that without both the plan and the counterplan the meaning of the data is incomplete, i.e., partial. Thus, under this system of inquiry, the plan and the counterplan which constitute the theory sector are prior to the input sector and indeed constitute opposing conceptions of the whole system. Finally, it is also assumed that on every issue of importance, there can be found or constructed a plan and a counterplan; i.e., a dialectical debate can be formulated with respect to any issue. On any issue of importance there will be an intense division of opinion or feeling.

Hegelian, or Dialectical, IS are the epitome of conflictual, synthetic systems. On any problem, they build at least two, completely antithetical, representations of it. Hegelian IS start with either the prior existence (identification) of or the creation of two strongly opposing (contrary) Leibnizian models of a problem. These opposing representations constitute the contrary underlying assumptions regarding the theoretical nature of the problem. Both of these Leibnizian representations are then applied to the same Lockean data set in order to demonstrate the crucial nature of the underlying theoretical assumptions, i.e., that the same data set can be used to support either theoretical model. The point is that data are not information; information is that which results from the interpretation of data. It is intended that out of a dialectical confrontation between opposing interpretations (e.g., the opposing "expert" views of a situation), the underlying assumptions of both Leibnizian models (or opposing policy experts) will be brought up to the surface for conscious examination by the decision-maker who is dependent upon his experts for advice. It is also hoped that as a result of witnessing the dialectical confrontation between experts or models, the decisionmaker will be in a better position to form his own view (i.e., build his own model or become his own expert) on the problem that is a "creative synthesis" of the two opposing views.

In considering the resource allocation and decision processes which govern our society and institutions, the role of the "expert" has become somewhat confused and clouded. In a historical perspective the emergence of systems analysts, efficiency or productivity experts, and operation researchers can be viewed as the establishment of a new group of advocates. They advocate decisions, policies, and actions which may optimize certain unique measures such as benefits, costs, efficiency, etc. However, their training does not enable them to reflect on all the factors which the decisionmaker must account for in the process of reaching a decision. Perhaps part of the problem we have had in the past is a misconception that the "expert" has the only view pertinent to the decision and our error in our not attempting to balance and place in perspective the views arising from political, sociological, psychological and ethical considerations which may advocate alternative options. Perhaps "experts" can be better used by the decision processes if they are viewed from the perspective of the Hegelian inquirer as just *one component* of the decision analysis process. This view of the use of expertise underlies concepts such as the Policy Delphi.

Whereas, in the Lockean IS the guarantor of the validity of a proposition is agreement, in the Hegelian it is intense conflict, i.e., the presumption that conflict will expose the assumptions underlying an expert's point of view that are often obscured *precisely because* of the agreement between experts. Hegelian IS are best suited for studying "wickedly" ill-structured problems. These are the problems that, precisely because of their ill-structured nature, will produce intense debate over the "true" nature of the problem. Conversely, Hegelian IS are extremely unsuited to well-structured, clear-cut problems because here conflict may be a time-consuming nuisance.

Except for the Policy Delphi concept of Turoff (see Chapter III, B, 1,3), the use of conflict as a methodology is conspicuously absent in the field of technological forecasting or in Delphi studies in general. In the Policy Delphi the communication process is designed to produce the best underlying pro or con arguments associated with various policy or resource allocation alternatives. In a non-Delphi mode of communication (e.g., face to face), one of the most interesting applications can be found in the activity of corporate or strategic planning. In an important case study, Mason[3] literally pioneered the development of what may be termed the Dialectical Policy inquirer. The situation encountered by Mason was one in which the nature of the problem prevented traditional well-structured technical approaches to planning (i.e., Leibnizian and Lockean methods) from being used.

In the company situation studied by Mason, there were two strongly opposing groups of top executives who had almost completely contrary views about the fundamental nature and management of their organization. They were faced with a crucial decision concerning the future of their company. It was literally a life-and-death situation, since the decision would have strong repercussions throughout all of their company's activities. The two groups each offered fundamentally differing plans as to how to cope with the situation. Neither of the plans could be proved or "checked out" by performing any technical study, since each plan rested on a host of assumptions, many of them unstated, that could probably never be verified in their entirety even if time to do this were available, which it wasn't. Indeed, if the executives wanted to be around in the future to check on how well their assumptions turned out, they had to make a decision in the present. It was at this point that the company agreed to let Mason try the Dialectical Policy inquirer to see if it could help resolve the impasse and suggest a way out.

After careful study and extensive interviews with both sides, Mason assembled both groups of executives and made the following presentation to them: First, he laid out side by side on opposite halves of a display board what he took to be the underlying assumptions on which the two groups were divided. "Thus, for every assumption on the one side there was an opposing assumption for the other side. It is important to appreciate that this had never been done before. Prior to Mason's contact, both groups had never fully developed their underlying positions. They were divided, to be sure, but they didn't know precisely how and why. In this sense Mason informed both groups about what they "believed" individually. Next, Mason took a typical set of characteristic operating data on the present state of the company (profit, rate of return on investment, etc.) and showed that every piece of data could be used to support either the plan or the counterplan; i.e., there was an interpretation of the data that was consistent with both plans. Hence, the real debate was never really over the surface data, as the executives had previously thought, but over the underlying assumptions. Finally, as a result of witnessing this, both groups of executives were asked if they, not Mason, could now formulate a new plan that encompassed their old plans. Fortunately in this case they could and because of the intense and heated debate that took place, both groups of executives felt that they had achieved a better examination of their proposed course of action than normally occurred in such situations.

Of course, it should be noted that such a procedure does not guarantee an optimal solution. But then, the DIS (Dialectical Inquiring System) is most applicable for those situations in which the problem cannot be formulated in pure Leibnizian terms for

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[3] Richard Mason "A Dialectical Approach to Strategic Planning," Management Science 15, No. 8 (April 1969).

which a unique optimal solution can be derived. DIS are most appropriate for precisely those situations in which there is no better tool to rely on than the opinions of opposing experts. If the future is 99 percent opinion and assumption, or at least in those cases where it is, then the DIS may be the most appropriate methodology for the "prediction" and "assessment" of the future.

It is important to appreciate that the DIS and Policy Delphis differ fundamentally from other techniques and procedures that make use of conflict. In particular, they differ greatly from an ordinary courtroom debate or adversary procedure. In an ordinary courtroom debate, both sides are free to introduce whatever supporting data and opposing arguments they wish. Thus, the two are often confounded. In a DIS, Hegelian inquirer or Policy Delphi, the opposing arguments are kept strictly apart from the data so that the crucial function of the opposing arguments can be explicitly demonstrated. This introduces an element of artificiality that real debates do not have, but it also introduces a strong element of structure and clarity that makes this use of conflict much more controlled and systematic. In essence, the Hegelian Inquiry process dictates a conceptual communication structure which relates the conflict to the data and the objectives. Under this conception of inquiry, conflict is no longer antithetical to Western science's preoccupation with objectivity; indeed, conflict actually serves objectivity in this case. This will perhaps be puzzling to those who have been brought up on the idea that objectivity is that upon which men can agree and not on what they disagree. While the Hegelian inquirer does not always lead to a new agreement (i.e., a new plan), the resulting synthesis or new agreement, when it occurs, is likely to be stronger than that obtained by the other inquirers.

Singerian-Churchmanian IS

Singerian IS are the most complicated of all the inquirers encountered thus far and hence the most difficult to describe fully. Nevertheless, we can still give a brief indication of their main features as follows:

(1) Truth is *pragmatic; i.e.,* the truth content of a system is relative to the overall goals and objectives of the inquiry. A model of a system *is teleological, or* explicitly goal-oriented, in the sense that the "truth" of the model is measured with respect to its ability to define (articulate) certain systems objectives, to propose (create) several alternate means for securing these objectives, and finally, at the "end" of the inquiry, to specify new goals (discovered only as a result of the inquiry) that remain to be accomplished by some future inquiry. Singerian inquiry is thus in a very fundamental sense nonterminating though it is response oriented at any particular point in time; i.e., Singerian inquirers never give final answers to any question although at any point they seek to give a highly refined and specific response.

(2) As a corollary to (1), Singerian IS are the most strongly coupled of all the inquirers. No single aspect of the system has any fundamental priority over any of the other aspects. The system forms an inseparable whole. Indeed, Singerian IS take *holistic thinking* so seriously that they constantly attempt to sweep in new variables and additional components to broaden their base of concern. For example, it is an explicit

postulate of Singerian inquiry that the *systems designer* is *a fmclamental part of the system*, and as a result, he must be explicitly considered in the systems representation, i.e., as one of the system components. The *designer's psychology and sociology are inseparable from the system's physical representation.*

Singerian inquirers are the epitome of synthetic multirnodel, *interdisciplinary* systems. In effect, Singerian IS are meta-IS, i.e., they constitute a theory about all the other IS (Leibnizian, Lockean, Kantian, Hegelian). Singerian IS include all the previous IS as submodels in their design. Hence, Singerian inquiry is a theory about how to manage the application of all the other IS. In effect, Singerian inquiry has been illustrated throughout this chapter in our descriptions of the inquirers, for example, in our previous representations of the inquirers and in our discussions of which kinds of problems the inquirers are best-suited to study. A different theory of inquiry would have described each of the preceding inquirers differently.

Singerian IS contain some rather distinctive features which none of the other IS possess. One of their most distinctive features is that they speak almost exclusively in the language of commands, for example, *"Take* this model of the system as the "true" model (or the true model within some error limits +_ E)." The point is that all of the models, laws, and facts of science are only approximations. All of the "hard facts" and "firm laws" of science, no matter how "well-confirmed" they are, are only hypotheses, i.e., they are only "facts" and "laws" providing we are willing to accept or make certain strong assumptions about the nature of the reality underlying the measurement of the facts and the operation of the laws. The thing that serves to legitimize these assumptions is the command, in whichever form it is expressed, to *take* them seriously, e.g., *"Take* this is as the true model underlying the phenomenon in question so that with this model as a background we can do such-and-such experiments." Thus, for example, the Bohr model of the atom is not a "factually real description of the atom," but if we regard it as such, i.e.,. if we *take it* as "true," then we can perform certain experiments and make certain theoretical predictions that we would be unable to do without the model. What Singerian inquirers do is to draw these hidden commands out of every system so that the analyst is, he hopes, in a better position to choose carefully the commands he wishes to postulate. Although it is beyond the scope of this chapter, it can be shown how this notion leads to an interesting reconciliation between the scientist's world of facts (the language of "is") and the ethicist's world of values (the language of "ought"). In effect, *Singerian inquiry shows how it is possible to sweep ethics into the design of every system.* If a command underlies every system, it can be shown that *behind every technical-scientific c system is a set of ethical presuppositions.*

Another distinctive feature is that Singerian IS greatly expand on the potential set of systems designers and users. In the extreme, the set is broadened to include all of mankind, since in an age of larger and larger systems nearly everyone is affected by, or affects, every other system. While the space is not available here to discuss the full implications of this proposition, it can be shown that *every Singerian IS* is *dependent upon the future for its complete elucidation.* If the set of potential users for which a system exists is broadened to include all of mankind, then this implies that every system must be designed to satisfy not only the objectives of the present but also the objectives of the future. Thus, a Singerian theory of inquiry is explicitly concerned with the future and is by definition involved with the forecasting of the future. Singerian IS attempt to base their forecast of the future on the projections of as many diverse disciplines, professions, and types of personalities as possible.

Singerian inquiry has been conspicuously absent from the field of Delphi design; hence, unfortunately, we cannot talk about any current applications of Singerian IS to Delphi. There are hints of Singerian overtones in those few Delphis that ask people for the contrast in their real views and the views they would state publicly. However, none of these has ever explored the underlying values and psychology to the extent of warranting a Singerian label. Nevertheless, we can say something about what a Singerian Delphi would look like.

Of all the many features that Singerian inquiry could potentially add to Delphi design, one of the primary ones would be a general broadening of the class of designers. That is, at some point the participants should not merely participate in a Delphi but be swept into its design as well. In a Singerian Delphi, one of the prime features of the exercise would not only be to add to our "substantive knowledge" of the subject matter under investigation, but just as much, to add to the participants' knowledge of themselves. How do the participants change as the result of participating in a Delphi? Are their conceptions of polity formation, and of who and what constitutes an "expert," the same afterwards as before? How is it possible to sweep the participants more actively and more consciously into the design of the Delphi? What are the values and/or psychology that led me and my fellow respondents to answer with this view? These are only a very few of the many issues with which a Singerian-designed Delphi would be concerned, and as a result, would thus act to build into the design of the Delphi the potential for pursuing these questions systematically. In short, a Singerian-based Delphi is concerned with raising and building explicitly into the design of the technique *the self-reflective question; How do I learn about myself in the act* of *studying others and the* world? Why is it that some minds think they can best learn about the world and the contents of other minds (i.e., their communications) by formal models only? Why do others believe they can best learn through empirical consensual means, and others still, through multiple synthetic or conflictual means? And finally, why do Singerians want to spend so much time studying the others? What kind of mind is it that studies others? Perhaps, perverse; most certainly, reflective-the very spirit that moved the first pioneers of the Delphi technique to want to study how and under which circumstances a *group* of reflective minds was better than one.

Concluding Remarks

In many ways a brief commentary on the strengths and weaknesses of Singerian inquiry provides the most fitting summary to this chapter.

The strength of Singerian inquiry is that it gives the broadest possible modeling of any inquirer on any problem. The weakness is the potentially prohibitive cost involved in comprehensive modeling efforts. However, given the increased fear and concern with our environment, we may no longer have the choice but to pay the price. We may no longer be able to afford the continued "luxury" of building large-scale Leibnizian and Lockean techrological models that are devoid of serious and explicit ethical considerations and which fail to raise the self-reflective question. We certainly no longer seem able to afford the faulty assumption that there is only one philosophical base upon which a technique can rest if it is to be "scientific." Indeed if our conception of inquiry is "fruitful" (notice, not "true" or "false" but "productive") then to be "scientific" would demand that we study something (model it, collect data on it, argue about it, etc.) from as many diverse points of view as possible. In this sense strict Leibnizian and Lockean modes of inquiry are "unscientific" because they inhibit this effort, a conclusion which we are sure most of our "scientific" colleagues would be surprised to find and even more reluctant to accept. But then, believing in conflict as we do, we might have a good debate on the matter. If one were to design a Delphi to investigate the matter, which Delphi inquirer design do you think we (you) ought to use?

References

The references listed below are intended to provide the reader with general reviews, further background, and some specific examples of topics covered in the article. On the subject of Inquiring Systems the best place to seek further explanation would be:

C. West Churchman, The Design of Inquiring Systems, Basic Books, New York, 1971.

Those interested in attempts to construct formal mathematical representations of Inquiring Systems are directed to the following three articles:

Ian 1. Mitroff, "A Communication Model of Dialectical Inquiring Systems-A Strategy for Strategic Planning," Management Science, 17, No. to (June 1971), pp. 13634-13648.

Ian I. Mitroff and Frederick Betz, "Dialectical Decision Theory: A Meta-Theory of Decision Making," Management Science 19, No. 1 (September 1972), pp. 11-24.

Ian I. Mitroff, "Epistemology as a Basis for Building a Generalized Model of General Policy-Sciences Models," Management Science, special issue on "The Philosophy of Science of Management Science," to appear.

This chapter is, in large part, a specialization of an earlier more general article:

Ian I. Mitroff, and Murray Turoff, "Technological Forecasting and Assessment: Science and/or Mythology?" Technological Forecasting and Social Change, 5, No. I (1973).[4]

[4] A condensed version of the above directed to an engineering audience appeared in the March 1973 issue of Spectrum, which is the magazine of the institute of Electronic and Electrical Engineers.