Decision Making in Complex Systems.

Mildred L.G. Shaw
August 1978.
Middlesex Polytechnic.

Shaw, M. L. G. (1978). Decision making in complex systems. In Proceedings 3rd Conference on Decision Making in Complex Systems Pask, G., ed. Systems Research, Richmond, Surrey, UK.

Background.

My recent work has been in the area of human learning, using the computer to complement the abilities of man by offering new perspectives of his immediate problem and its context. A set of computer programs (FOCUS, PEGASUS, ARGUS, CORE, SOCIOGRIDS) has been developed which interact with the cognitive modelling processes of the participant, helping him to increase his awareweness of himself and his understanding of the world.

Personal construct psychology was developed by George Kelly to explain how similar events could produce different behaviour in different people. He used the repertory grid to elicit the unique dimensions along which each individual classifies his world. In 1955 he published his major work in which he describes his theory and attempts to understand man as a personal scientist who forms theories about his world, testing these against his personal experience, reviewing and revising his theories, anticipating on the basis of them, and acting on the basis of his anticipation.

The system of constructs is monitored by the computer in such a way as to provide immediate feedback to the participant on cross-references within the system as it is elicited from him at the terminal (PEGASUS, ARGUS). Using the basic philosophy of personal construct theory, conversational heuristics are employed which enable the computer to offer the facility of interactive and participative methods of analysis of this data, which extracts and displays the essence of the subjectively and personally meaningful relationships in a single grid(FOCUS), a pair of grids (CORE), or a group of grids (SOCIOGRIDS). In this way each person is offered a view of himself and his relationships in a non-directive and supportive environment as he is developing his personal models of the world.

These techniques have been applied in a wide variety of situations including studies on aspects of self represented by role perspectives, the personal and family relationships of two adolescents in a psychiatric unit, staff appraisal in industry, and quality control in a knitwear factory. Most of this work has been done in conjunction with Dr. Laurie Thomas at Brunel University.

Applications to Decision Making.

Decision making can be seen as part of a complex process which also includes such activities as problem formulation, problem solving, concept formation, and model building. Much of Kelly's Theory may be read with a decision theorist's eye ; the fundamental postulate states that "a person's processes are psychologically channelized by the ways in which he anticipates events". Many of the eleven corollaries supporting this postulate lead one to suppose that the decision theorist is facing exactly the same problems. For example, the choice corollary states that "a person chooses for himself that alternative in a dichotomised construct through which he anticipates the greater possibility for extension and definition of his system" ; the decision theorist might say : a decision maker chooses for himself among several options or alternatives that option which yields the highest expected utility.

There are similar parallels in the others, notably the individuality corollary which discusses individual differences ; the organization corollary which suggests that each individual builds a system of levels of organization, either a hierarchy, a heterarchy, or a lattice ; the dichotomy corollary which suggests that a finite number of alternative paths are available in the system of an individual. This set of corollaries was used as a basis for the development of the current technology using the repertory grid.

PEGASUS is an interactive computer program which can be used to exteriorize the decision-making process by acting as a psychological (cognitive and affective) reflector of the individual's system of personal constructs. The individual may be regarded in a Paskian sense as a participant in a conversation

either one of several in one head, a pair, or a group or organisation. This system makes visible the links, analogies, and information available of which the individual is unaware. If it is thought that a good decision-maker is one who keeps his options open until sufficient information is known to make the choice on obvious one, PEGASUS can be seen as a tool for uncovering and teasing out this information which may be implicitly available but covered by layers of prejudice, dogma, company policy or personal values, which in the event are irrelevant.

PEGASUS first requires the user to specify his purpose for eliciting a repertory grid. This can be seen as a way of saying that decision-making is context dependent or task specific. The elements are chosen to span the universe of discourse defined by the purpose or context, and the constructs are formed by making distinctions or categorizing the elements into classes or sets. The elements which have been used vary from people (family, friends, acquaintances, subordinates), events (training courses, classroom interaction, industrial inspection), physical objects (books, faults in garments, sculptures, breakfast cereal), to abstract entities (careers, architectural styles, magistrates' sentences, statistical tests). The total process may be seen as a way of defining the context, formulating alternatives, weighing values, and assigning subjective probabilities to events.

SOCIOGRIDS is a program which analyses the results of experience in a small group or organisation. The negotiated elements sample the universe of discourse of the common problem and each person elicits his own grid using personal constructs. The constructs from each person represent similar or different thoughts and feelings on the subject. Any pair of grids can be matched one with the other to obtain a measure of overlap or commonality of construing. The FOCUS algorithm, which is used to analyse a grid by re-sorting the rows and columns to highlight similarities and differences, provides a method for doing this. All possible pairs in the group are analysed in this way and a series of sociometric - like diagrams are drawn, designated "socionets", to illustrate patterns of similarity and dissimilarity of construing within the group. In addition, all the

constructs from each individual are classified in terms of the extent to which they are shared. A "mode grid" is constructed from those constructs most frequently used by members of the group and is used as a common referent with which each individual is compared.

The Delphi technique used in conjunction with SOCIOGRIDS makes use of the mode grid to allow each individual in the group to clarify his judgements in the light of the constructs most used by the group, and to revise his constructs to highlight his position in the group if he wishes to do so. If an area of public or group knowledge (as elicited with SOCIOGRIDS) is to be communicated to an individual, this can be done with the use of PEGASUS-BANK which stores the group knowledge as a bank of constructs in the computer. As the individual elicits his personal grid continual comparison with the bank gives feedback on how his constructs map on to the group view of the same elements.

In conclusion, these repertory grid based programs offer the decision theorist a new perspective from which to tackle the problem of decision making in complex systems.

References.

KELLY,G. (1955). "A theory of Personal Constructs." Norton.

SHAW,M.L.G. "On Becoming a Personal Scientist : Interactive Computer Elicitation of Personal Models of the World." Academic Press. (In press)