Reflective analysis

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The paper describes a method of computer assisted reflective learning capable of being used by managers. The method enables managers to explore the value of their past experience in relation to a particular problem context; to consider how their own experience relates to that of other managers; and finally to create design criteria for strategic options within a problem context capable of commanding a consensus between the managers. The paper concludes that the method represents a new departure in the use of computers for supporting strategic management.

Introduction

The methods described in this paper were developed within a project funded by the London Graduate School of Business Studies and the National Development Programme in Computer Assisted Learning: the Management Decision-making Project. The methods are an example of how software developed by that Project can be used. The software and its application are now supported by the Management Learning Project based at the London Business School and funded by the Manpower Services Commission. The aim of this paper is to describe how the author uses that software for supporting reflective learning, rather than to describe the characteristics of the software itself.

The Management Decision-making Project (Hooper, 1977; Fielden & Pearson, 1978) was set up to produce learning techniques capable of developing the intuitive, qualitative and judgmental aspects of decision-making. It was based on the assumption that there is something beyond rational, analytic and objective decision-making which the practising manager could recognise even if the academic could not. Loosely referred to as judgement, such processes become most apparent when non-routine decisions have to be made and the manager is involved in breaking new ground; or when the decisions to be made are themselves hard to define because of the ambiguous nature of the circumstances in which the need for a decision has arisen.

The hypothesis was that the rational analytic mode of decision-making could be explained wholly by reference to phenomena external to the decision-maker: as a mode of decision-making it was therefore wholly *object-referenced.* Judgement on the other hand involved the decision-maker in reference to the quality of his own past experience: it used knowledge that was *subject-referenced* (Boxer, 1978). Subject-referenced knowledge was therefore vitally different from object-referenced knowledge because its expression had to be subject centred, and it had to be observed relative to the subject's point of view. This paper describes a method of enabling managers to explore their subject-referenced knowledge in relation to a particular problem context. Boxer (1980) describes the theoretical basis underlying the design of this method.

The assumptions underlying the use of the method described in this paper are firstly that a group of managers using it will be faced with a problem which exists within the context of their organisation as a whole; and secondly, that the managers

will be interdependent in their capacity to act on the problem. The figure below identifies three facets of the method for exploring subject-referenced knowledge: firstly Reflective Analysis, concerned with enabling the manager to recognise his own subject-referenced knowledge in relation to the problem context; secondly Consensus Generation, providing a way of enabling each manager to explore the relatedness between his own and each other manager's subject-referenced knowledge; and thirdly Strategic Design, building on the shared language negotiated between the managers by examining value trade-offs between the managers as a result of selecting different strategic options.
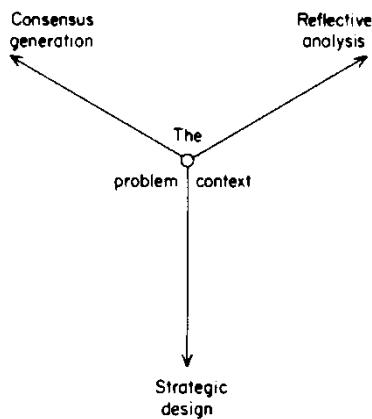
The method described in this documentation is not intended as an alternative to, or in any way a replacement for the various analytical methods already familiar to managers. Rather the method's focus on subject-referenced knowledge should be seen as providing an essential complement to the typically object-referenced nature of other methods. Throughout the paper there is an example of the use of the method, shown as computer printout. The characters typed by the user have been underlined, and the examples given are personal, being an individual's reflections. The content of the examples concerns the purchase of a motor-car: this example has been chosen because it is a practical problem which many readers will have had to face. It is also a problem which clearly involves qualitative subject-referenced values as well as a need for some hard-headed analysis.

Supporting reflective learning

Underlying the distinction between subject-referenced and object-referenced knowledge is an interpretation of George Kelly's Theory of Personal Constructs (Kelly, 1955). The operationalisation of that distinction in the method being described here has been based on the principles of Repertory Grid Analysis (Fransella & Bannister, 1977). The explanation of the theoretical basis on which the method is constructed is given more fully elsewhere (Boxer, 1980), and what follows summarises aspects of that paper.

PERSONAL CONSTRUCTS

Kelly's conception of mind was that it served a useful function for the individual by anticipating experience, whether that experience was internal or external. Kelly's theory (itself a construction) was that mind "construed" experience, and the name he gave to the construing process was the "construct". He then went on to say that 'constructs' could be thought of in two ways: either as *pre-empting* experience from being construed in alternative ways; or as not pre-empting but rather *relating* experience to other experience. The former mode of construing he described in terms

of "pre-emptive" and "constellatory" constructs, depending on the degree to which the construct excluded other ways of construing; and the latter he described in terms of "propositional" constructs. The method described in this paper represents the pre-emptive or constellatory construing as experiences, options or elements: *what* is experienced; and it represents propositional construing as concepts of value or adjective pairs: the *how* of experiencing.

The distinction made by Kelly is the one made earlier between object-referenced and subject-referenced knowledge. In terms of a problem and its context, a description of the content of a problem is pre-emptive. It serves its purpose of controlling by excluding and making particular and definite what would otherwise be general and amorphous. The description of the problem in relation to its context on the other hand is propositional. While being based on an assumption about content, it serves the purpose of relating. A propositional description identifies dimensions of relatedness between the current content of the problem and managers' past or imagined alternative definitions of the problem. The analysis of subject-referenced knowledge thus provides the manager with a means of integrating his experience and dealing with problems in relation to their context.

Pre-emptive and constellatory constructs form a class of concepts therefore which are object-referenced: they can be communicated by exclusive reference to the objective content of experience. Propositional constructs, however, form a special class of concepts which are subject -referenced: they can only be communicated by reference to the individual's experience of the problem content/context boundary - his point of view. The name given to the expression of this form of construing is *core structure*. Reflective Analysis has been developed as a method of enabling the individual to reflect on the nature of his core structure. The method acts as a device for enabling the individual to reflect on similarities implicit in his concepts of relatedness: a process which enables him to develop his awareness of his own core structure as a whole.

These similarities identify underlying patterns in "how" the individual has experienced: the quality of his experience.

USING REFLECTIVE ANALYSIS

Within the software supported by the Management Learning Project ("NIPPER") there exist six programs written by the author and referred to collectively as Reflective Analysis. The programs are concerned with helping the manager know his point of view both in relation to his past experience (Reflective Analysis) and also in relation to the views of others (Consensus Generation). The programs also help a manager or group of managers to create design criteria in terms of their values (Strategic Design). The techniques of analysing and designing organisation structures in terms of the design criteria of managers within an organisation are dealt with elsewhere, being beyond the scope of this paper (Boxer, 1979). Within the three facets of the method, Past Reflection allows the manager to explore core structure in relation to his own past experience. He selects the past experience on the basis of its relevance to the current problem. Option Analysis enables him to consider how that core structure impacts on a present set of options within the problem context. Concept Analogies then allows the manager to draw on other managers' experience when there is no common set of options or past experiences. Role Network Analysis looks at what variety of value perspectives exist relative to the problem amongst a group of managers. Exchanging Views allows those managers to see in detail how their views

differ relative to the problem; and finally Consensus Grouping allows the group of managers to perform an option analysis collectively:

```
EXE-*NIPPER
NIPPER

NIPPER SYSTEM COPYRIGHT 1977 C.E.T.
----------------------------------------

Further information from: MANAGEMENT LEARNING PROJECT,
                          LONDON BUSINESS SCHOOL
                          SUSSEX PLACE, REGENTS PARK
                          LONDON  NW1 4SA
                          (Phone 01-724 1517)


* OBEY REFLEX




         REFLECTIVE ANALYSIS
         *********************


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EXPLANATION?
?YES
These programs have been written to support Reflective
Learning and the generation of consensus between managers:

      1. Identifying concepts of value based on a manager's
         past experience and relevant to the evaluation of
         current options - PAST REFLECTION.
      2. Evaluating current options in terms of concepts
         of value - OPTION ANALYSIS.
      3. Evaluating current options in terms of another
         manager's concepts of value when there are no
         shared options - CONCEPT ANALOGIES.

      4. Identifying how other managers' values differ in
         relation to a shared problem- ROLE NETWORK ANALYSIS.
      5. Identifying how another manager's concepts of value
         relate to your own - EXCHANGING VIEWS.
      6. Identifying groups of options which can form a basis
         for collective action between managers with a
         shared problem - CONSENSUS GROUPING.
```

The figure below summarises these different programs in terms of the three ways of exploring subject-referenced knowledge shown earlier:
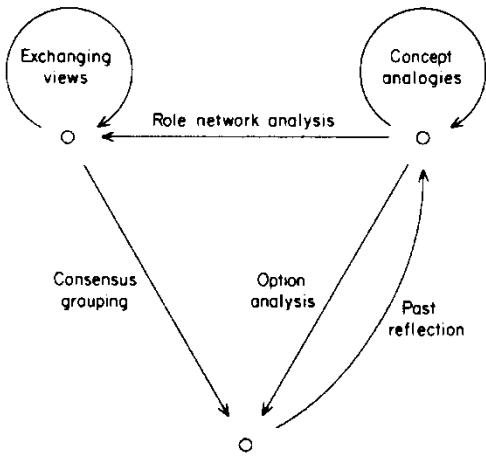
The difficulty with using the method is the fact that a manager will act on and react to external events in ways which through examination by himself and others will reveal a "theory-in-use": there will be patterns or regularities in his behaviour which he may or may not be conscious of. Equally the manager will talk about himself and external events and seek to explain his actions and the actions of others: he will have an "espoused theory" of action (Argyris & Schon, 1974). The manager's actions and therefore his theory-in-use will be influenced by his personal feelings, preferences,

ambitions and particular experiences as well as by the constraints of the problem and its context. If the manager wishes it to be so, there need be little connection between what he says and what he does. No amount of reflection will change this, and thus use of the method will have little impact on the problem.

The value of the method, however, follows from the fact that much of the split between managers' espoused theories and theories-in-use comes from the manager's inability to incorporate context and value in his espoused theories. The method of supporting reflective learning provides him with a way of learning to do this, by providing the manager with a medium sensitive to the expression of concepts of value and relatedness - his core structure. Thus the benefit which follows from using the method is the possibility of improving the manager's ability to deal with himself and the organisation as a whole; of improving the quality of lateral communication between managers; and of developing the organisation's capacity to function as a whole. The use of the method is therefore most appropriate for managers likely to have the greatest difficulty in keeping espoused theories and theories-in-use congruent: managers in complex organisations who are concerned with managing structural change, and who work with a high degree of functional specialisation and interdependency in their organisation's activities.

CONCEPTS OF VALUE

Past Reflection provides a method whereby the concepts of value implicit in an individual's preferences can be distilled out of his experience of past problems which he can remember as being relevant.

```
CHOOSE ONE OF THE FOLLOWING:


FORMS FOR REMOTE USE?
?NO
PAST REFLECTION?
?YES
HP2640 TERMINAL?
?NO
```

Past Reflection enables the user to consider a number of different sets of past experiences which might be relevant to the current problem. In each case the user identifies the content of the past experience (the element experiences) and different concepts of value which he feels are significant.

```
PAST REFLECTION
****************


PLEASE ENTER IDENTITY CODE ? 4
FILE NUMBER?
?1
DATA ON FILE?
?NO
HOW MANY ELEMENT EXPERIENCES?
?5
ENTER 5   20 CHARACTER LABELS FOR THEM
< TR4A
< ROVER TC
< FIAT 131
< CITROEN GS
< RENAULT 12
HOW MANY EVALUATIVE CONCEPTS?
?13
ENTER 13   20 CHARACTER LABELS FOR THEM
< COMFORTABLE
< COSTLY TO RUN
< ROOMY
< DIFFERENT
< WELL FINISHED
< EASY TO MAINTAIN
< GOOD VALUE
< ROBUST
< FLEXIBLE
< TINNY
< WELL DESIGNED
< POWERFUL
< AIRY
```

Through a process of reflecting on how he feels about those past experiences, the user can identify patterns along a continuum which reflect how he feels about each experience in relation to the other experiences.

```
WHEN RATING THE ELEMENTS AGAINST EACH CONCEPT
USE LETTERS TO REPRESENT THE ELEMENTS AS FOLLOWS:
        a    TR4A                    b    ROVER TC
        c    FIAT 131                d  - CITROEN GS
        e    RENAULT 12


                        LOW                                                    HIGH
COMFORTABLE             !------------------------------------------- ---   --  !
XXXXX                   ?                   A EC          D            B
COMFORTABLE             !----------------------a .ec------   d------b------!
OK ? YES
```
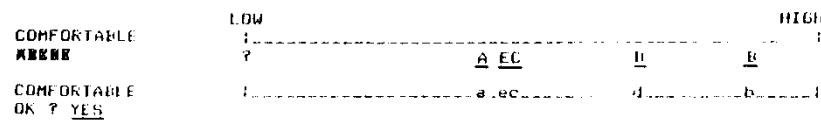
This pattern defined by the user is the "meaning" for him of the particular concept of value in terms of those particular experiences. The process of becoming conscious of and expressing these patterns is fundamental to the process of reflection. The user can take a very long time and derive a great deal of insight purely through defining these patterns.

```
COSTLY TO RUN       !--- ------------------b--e--- c-- d----- ------a---!

ROOMY               !------ -------a---------------- --c ------ db-----e---!

DIFFERENT           !-------e-c---------------d----- b ----- ------ - a---!

WELL FINISHED       !--- - ----c- ------ -- a ------ e      ------d--- ---b---!

EASY TO MAINTAIN    !----d------------b---c--a----- - ---- e----- ---- !

GOOD VALUE          !- - --a - ---- c ----d- ----- b --- e ------!

ROBUST              !----------d----c----a-------b--- - --e ---- ------ --!

FLEXIBLE            !- - --- -------a ------c- d--- b - -e -- - ---!

TINNY               !-- - b --a---d------e---------- - - ---- ---c ---- !

WELL DESIGNED       !- --------c-------- e------a--- d           b ---!

POWERFUL            !-  -------d----e------c-- --- b ------a!

AIRY                !- --------d------c-- e  -b----- ----a--- !
```
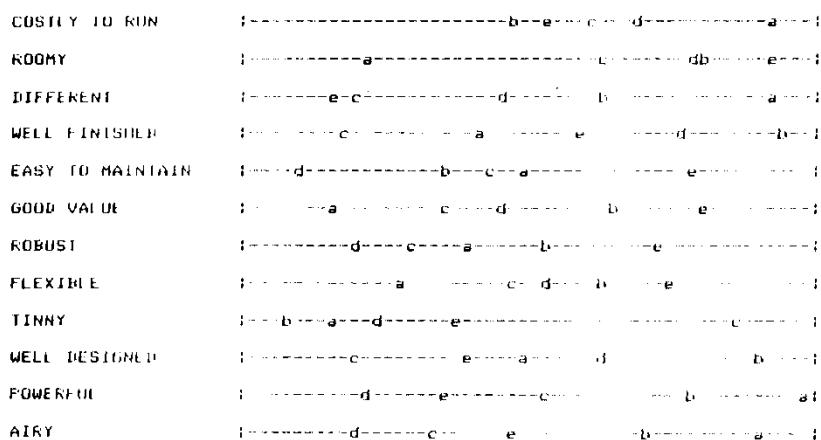
Assuming that the experiences chosen by the user are different in his mind, then the first thing that can be done is to check whether the differences which he has expressed correspond to his feelings about their differences. Concepts of difference are synthesised by the program in the computer, so that "TR4A" is difference of experiences to experience of TR4A.

```
EXPERIENCE DIFFERENCE?
?YES


EXPERIENCE DIFFERENCES:

        a  - TR4A                    b    ROVER TC
        c  - FIAT 131                d    CITROEN GS
        e  - RENAULT 12


                        LOW                                             HIGH

TR4A            !a -------- ----------- --- bc  d e         - ----      !

ROVER TC        !b-----------------d- e  a  c                          !

FIAT 131        !c-- ----------- - de   a  b                           !

CITROEN GS      !d ---------------  bce         a                      !

RENAULT 12      !e -----------------cdb        a      -- - -- -        !
```
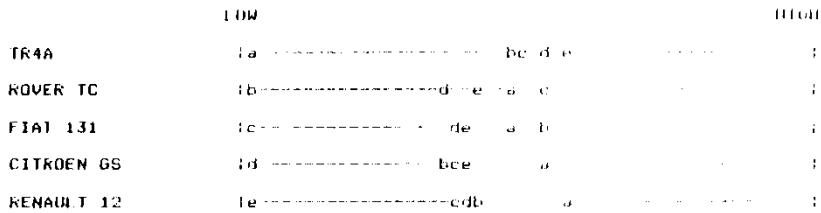
Thus the user can check that experiences which he feels ought to be very similar or different have in fact been expressed as such in terms of the concepts he has defined. If not, he can of course introduce new concepts to more clearly express his feelings. The program measures similarity or difference by calculating the Mean Absolute

Distance between element positions for all the concept continua used. This is easy to calculate by inspection of the original patterns, and thus makes it easy for the user to confirm his view of what the program is doing. (The program does this by mapping the continuum onto an arbitrary number interval chosen by the programmer for convenience and sensitivity to element position. In the example this interval is 0-99.) The measure is explained in detail in the next section.

Considering the adequacy of the concepts used to express the differences existing between the experiences is one way of expanding the capacity of the concepts identified to reflect those differences. The purpose of reflecting on past experience is, however, to locate the sources of the user's present preferences. Examining concept similarity provides the means whereby he can relate the individual concepts to his present sense of preference. The method provides three alternative analyses of similarity for doing this.

```
CONCEPT SIMILARITY?
?YES


SIMILARITY GROUPING OF CONCEPTS:


   ( 8) GOOD VALUE          AND FLEXIBLE           => A[ SOUNDNESS   ]
```

The two concepts which were most similar in the example were "good value" and "flexible". For the user, the concept of value which ran through both these concepts was the "soundness" of the car - the extent to which it was tried and tested in use. (The number at the left-hand side indicates that the user rated the experiences on average 8% differently along the continuum for these two concepts.) The next three most similar concept pairs were as follows:

```
(10) WELL FINISHED       AND WELL DESIGNED      => B[ ENGINEERED  ]
(10) POWERFUL            AND AIRY               => C[ SPORTY      ]
(12) EASY TO MAINTAIN    AND ROBUST             => D[ BASIC       ]
```

Again the user reflected on the underlying concepts, and thought of a concept label to identify their relatedness. The program assumed that the user could think of some appropriate label for each underlying concept and produced a label for it A[   ], B[   ], etc. It then replaced the pair of concepts by the new one. The next most similar grouping was:

```
   (12) COMFORTABLE         AND B[ ENGINEERED   ]      => E[ QUALITY     ]
```

"Comfortable" was closer to the pair of concepts "well finished" and "well designed" than to any other concept or group of concepts. The new concept underlying this similarity was for the user "Quality". The computer continued to hypothesise about similarities and the user continued to use them as a basis for reflection.

```
(19) ROOMY              AND A[ SOUNDNESS  ]   => F[ FAMILY      ]
(20) DIFFERENT          AND C[ SPORTY     ]   => G[ FLASH       ]
(24) COSTLY TO RUN      AND G[ FLASH      ]   => H[ EXTRAVAGANT ]
(30) E[ QUALITY    ]    AND F[ FAMILY     ]   => I[ BOURGEOIS   ]
(34) D[ BASIC      ]    AND TINNY             => J[ UTILITARIAN ]
(49) I[ BOURGEOIS  ]    AND H[ EXTRAVAGANT ]   => K[ ————        ]
```

The program also produced a "family tree" representation of the similarities between the concepts. The particular shape of this tree reflects the strengths of similarity between concepts, and thus has its own "gestalt". With experience of the method, the user learns to use the "family tree" as well as the verbal analysis.

```
                                    +--------* COMFORTABLE
                             E |
                      +----------+   |B|  ----* WELL FINISHED
                      |          | |B|
                      |          +---* WELL DESIGNED
                  I |
          +---------+
          |   :     |          +-----------* ROOMY
          |   :     |      F |
          |   :     +------+  |   +----* GOOD VALUE
      K |  |         +------A
      +-+  | |              +----* FLEXIBLE
      | |  | |
      | |  | |          +-------------* COSTLY TO RUN
      | |  | |      H |  +----------* DIFFERENT
      | |  +-------+  +-G+
      | |          |    |   +----* POWERFUL
  ----------+      |    +--C
      |            |       +-----* AIRY
      |            |
      |            |   +-----* EASY TO MAINTAIN
      |          D+-+
      |      +------+   +------* ROBUST
      |    J |
      +------+
             +-------------------* TINNY
```
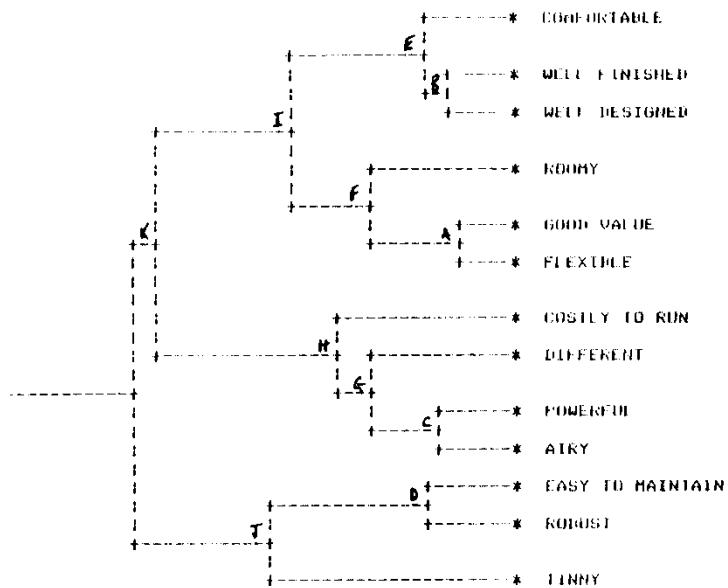
EXPRESSING CORE STRUCTURE

There are three different ways of examining similarity between concepts and each produces a slightly different insight into core structure. These different insights are used to enable the user to work towards four objectives in expressing core structure:

(1)   to identify *anchor groups* of concepts which correspond to significant dimensions of construing;

(2)   to *ground* those groups on the content of experience with concepts which arise directly out of that experience;

(3)   to *spread* the concept structure over as wide an area of construing as possible;

(4)   to be able to make *normative* statements relating the concepts to the individual's overall evaluative point of view.

Each concept label identifies an adjective pair, one of which may simply be the negative of the other, but which together break up the continuum into two parts. The breakpoint between these two parts corresponds to indifference between the two adjectives. Proceeding in either direction then corresponds to increasing degrees of the concept identified in terms of one or other of the adjective pair.

For example the user's concept "Tinny" refers to a continuum:

```
                    low                      high
Tinny:              _____
                         A      B          C
```
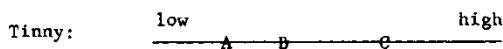
"Tinny" is the name for the continuum as a whole. However, if the user considers particular positions on the continuum, then he may feel that "low tinniness" is more like "solid" for him. The continuum therefore can be thought of as follows:

```
                    low                      high
Tinny:              _____
                         A    B             C
                       SOLID      TINNY
```
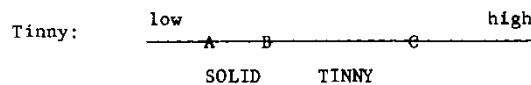
A is fairly solid (not at all tinny), C is tinny (not solid), and B is neither very tinny nor particularly solid - the user is indifferent. Working "up" a family tree (to the left) involves reflecting on how these adjective pairs relate to each other explicitly. Working "down" a family tree (to the right) involves reflecting on adjective pairs implicitly related to the ones explicitly labelled, possibly with a view to introducing

new concepts into the structure. The basic similarity grouping produced earlier enables the user therefore both to identify anchor groups and also to ground concepts. To make this easier it uses a method which produces very tight groupings.

In the example, the user used the verbal analysis to reflect on underlying concepts associated within each of the groupings. Thus "soundness" identified for him the underlying pattern which came to mind when considering what he experienced when both "flexibility" and "good value" were present. Equally "engineered" underlay his experience of "well finished" and "well designed" when he considered the particular experiences. In each case, he could think of a concept, except for the combination of "bourgeois" and "extravagant", which he rejected: although he could think of a label, he did not feel that it had any meaning for him. The results of his reflections therefore were *anchor groups* identified as follows:

1. Bourgeois (1)
2. Extravagant (H)
3. Utilitarian (J)

Each one of these anchor groups corresponded to an area of related experiencing which made sense for the user as a whole, and which could be grounded on concepts which arose directly out of his experience of the experiences.

Each one of the concepts actually identified an adjective pair. Thus in the example the concepts were as follows:

comfortable	: uncomfortable	/ comfortable
well finished	: shoddily finished	/ well finished
well designed	: botched	/ well designed
roomy	: close fitting	/ roomy
good value	: shoddy	/ good value
flexible	: inflexible	/ flexible
costly to run	: costly to run	/ cheap to run
different	: run-of-the-mill	/ different
powerful	: spongy	/ powerful
airy	: claustrophobic	/ airy
easy to maintain	: awkward	/ easy to maintain
robust	: delicate	/ robust
tinny	: tinny	/ solid

In some cases, the opposite was a simple negative (e.g. comfortable/uncomfortable) and in others it was a different word (e.g. solid/tinny). The reason for splitting the concepts, however, was to consider how each one felt when applied to the particular elements/ experiences/options being considered. If a car was comfortable, the user would definitely prefer it to a car that was uncomfortable, *all other things being equal*. The same went for well finished and well designed cars. Close fitting cars, however, were not on reflection necessarily worse than roomy ones. The fact that the user did not feel a particular bias to either one or other of the "roomy" concepts suggested that it was not sufficiently grounded for this set of experiences. The technique for grounding "roomy" further therefore was as follows:

(1) split the concept into a pair;
(2) think of an opposite to each of the pair which is not the opposite in (1);
(3) decide whether you feel biased or not when considering the two pairs;
(4) if you still do not feel a bias, repeat this process (1-3) until you do.

Applying this technique to "roomy" the user had:

roomy	: boxlike	/ roomy

close fitting   : cramped   / close fitting

Both of these new pairs felt biased towards the right-handed one of the pair. The user could therefore introduce two new concepts and remove the old "roomy" in a new cycle of past reflection. As it happened the user felt biased about all the other concepts, ("do-something-about-it" was on the left in the list and "that's-what-I-prefer" was on the right). Going through this process of defining pairs and splitting where necessary produced a *grounded* set of concepts.

```
ALTERNATIVES?
?YES
LATERAL GROUPING?
?YES


SIMILARITIES BASED ON LATERAL GROUPING:

                                    +----------*  COMFORTABLE
                          +------b-+
                          +-----*-+
                          !      !+--------*  WELL FINISHED
                          :      !+-*-+
                         J!      +--------*  WELL DESIGNED
                         +-*-+
                         ! !  +----------------*  ROOMY
                         ! !  !
                         ! H!
                         !+*-*  +E+--------*  EASY TO MAINTAIN
                         ! ! +-E-+
                        J! !C! +---------*  ROBUST
                       +-*-+ +-+
                       ! !   !   A+------*  GOOD VALUE
                       ! !   +-----A-+
                       ! !      +------*  FLEXIBLE
                       ! !
                      K! ! +-------------*  DIFFERENT
               +------*+ ! !
               !       ! +-G-+
               !       ! !   C+--------*  POWERFUL
               !       ! +----C-+
               !       ! +--------*  AIRY
               ----- -  !
               !       +--------------------*  COSTLY TO RUN
               !
               +----------------------------*  TINNY
```
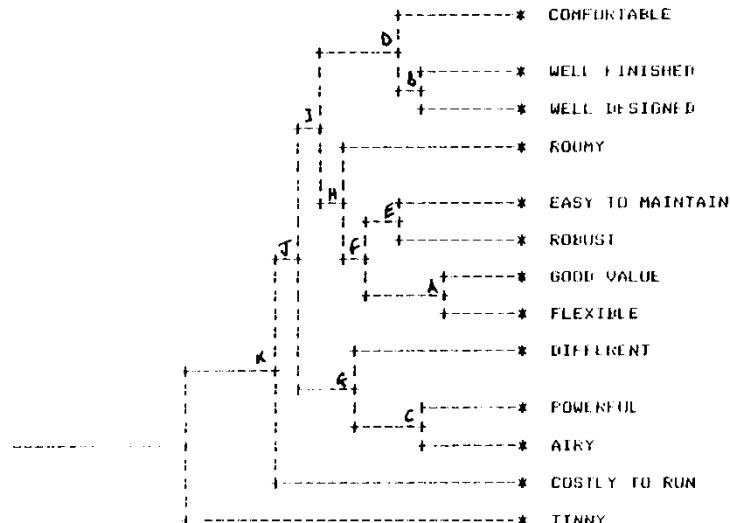
(8)	GOOD VALUE		AND	FLEXIBLE			A[	SOUNDNESS	]
(10)	WELL FINISHED		AND	WELL DESIGNED			B[	ENGINEERED	]
(10)	POWERFUL		AND	AIRY			C[	SPORTY	]
(10)	COMFORTABLE		AND	ENGINEERED	]		D[	QUALITY	]
(12)	EASY TO MAINTAIN		AND	ROBUST			E[	BASIC	]
(15)	E[BASIC	]	AND	A[SOUNDNESS	]		F[		]
(16)	DIFFERENT		AND	C[SPORTY	]		G[	FLASH	]
(17)	ROOMY		AND	F[	]		H[		]
(17)	D[QUALITY	]	AND	H[	]		I[		]
(20)	I[	]	AND	G[FLASH	]		J[		]
(22)	J[	]	AND	COSTLY TO RUN			K[		]

These groups were looked at after the anchor groupings had begun to become clear. The program created groups by adding concepts to a particular group if a concept was closer to one of the concepts within that group than to any other concept or group of concepts. The effect of this method of grouping was therefore to leave outlying concepts until last. This is reflected in the shape of the family tree. "Tinny" and "costly to run" were both outliers to all of the groups, and "roomy" was an outlier to the "bourgeois" anchor group. These outlying concepts might have formed the basis of new anchor groups. By reflection therefore, and considering ways in which these outlying concepts were different, the base of the structure could be widened through the introduction of new concepts.

```
MORE ALTERNATIVES?
?YES
LATERAL GROUPING?
?NO
GROUPING IGNORING SCALING?
?YES
```

SIMILARITY GROUPING (IGNORING SCALING)

```
                                              +  -  -*  COMFORTABLE
                              +----------- f|
                              |             |  |+-*  WELL FINISHED
                     +--  ----------------1|    +-C-|
                    |:                     |    |+-*  WELL DESIGNED
                   +K|                     |
                   |::                     +--------------- *  TINNY
                   |::
                   |::          +-------*  EASY TO MAINTAIN
                   |  +---------------------------------+
                   |                       +------*  ROBUST
                   |
 -- ----------+   |                        +------*  COSTLY TO RUN
              |   |          +-------------------+ +----*  ROOMY
              |   :         |                   E|   |
              |   |         |                    |+D+
              |   |         |                    |A| *  GOOD VALUE
              |   |         |                    +-|
              |   :    J|   |                     +-*  FLEXIBLE
              +--- --|   |
                  |   :                    +----  -*  DIFFERENT
                  :   +--------------H|
                  +--------------- --+    +|-*  POWERFUL
                                     |    +----B|
                                          +-*  AIRY
```
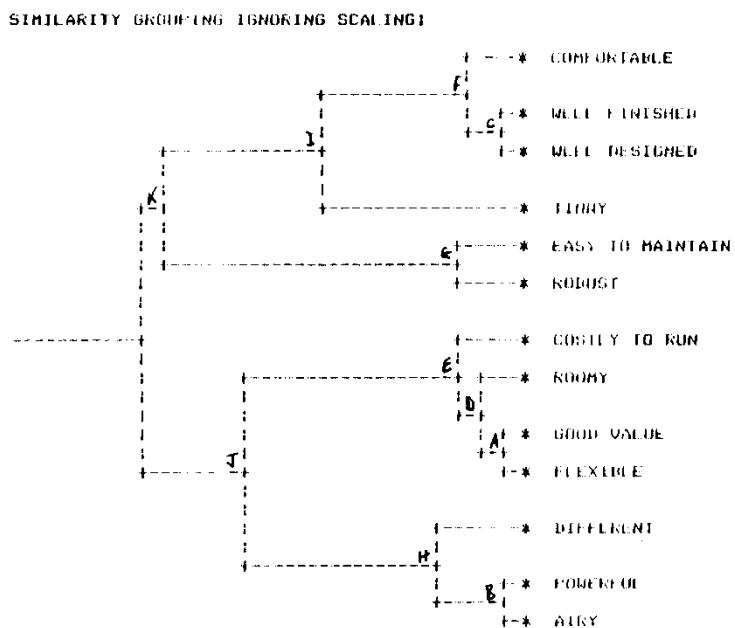
(99) GOOD VALUE	AND FLEXIBLE			AL SOUNDNESS	]
(93) POWERFUL	AND AIRY			HL SPORTY	]
(93) WELL FINISHED	AND WELL DESIGNED			CL ENGINEERED	]
(91) ROOMY	AND AL SOUNDNESS	]		DL FAMILY	]
(86) COSTLY TO RUN	AND DL FAMILY	]		LL	]
(84) COMFORTABLE	AND CL ENGINEERED	]		FL QUALITY	]
(84) EASY TO MAINTAIN	AND ROBUST			GL BASIC	]
(76) DIFFERENT	AND HL SPORTY	]		HL FLASH	]
(49) FL QUALITY	]	AND TINNY		IL	]
(26) EL	]	AND HL FLASH	]	JL	]
(7) IL	]	AND GL BASIC	]	KL	]

The final form of grouping was useful in making a normative statement based on the user's point of view after a well anchored, grounded and widely spread structure had been developed. The family tree created groups by ignoring the absolute rating positions on the dimensions, ignoring which way round the scale had been used, and using the same strong method of grouping as for the similarity grouping. The result therefore was a reduction in the number of groups, and an increase in the strength of association within the groups. (The program did this by using product moment correlations adjusted for element numbers, instead of mean absolute difference. The numbers in this case were therefore a measure of the probability of similarity.) The normative statement now resulted from considering which of the strong groupings included negatives. The car the user would buy had to be:

Comfortable, well finished and well designed;

not tinny;

easy to maintain and robust;

not costly to run, and roomy and good value and flexible; and

different, powerful and airy.

This last statement was the statement which could form the basis of an option analysis. Option analysis could now be used to see how these concepts applied to future choices available to the user. The point in making the statement was not that it could not have been made before, but that it now had a much clearer *foundation* in the user's past experience, which he could better express.

The three different family trees therefore formed the basis for reflecting on the nature of core structure. This reflection had four aims:

(1) to identify *anchor groups* of concepts;

(2) to *ground* these groups of concepts;

(3) to *spread* the base of concepts as widely as possible;

(4) to make *normative* statements of preference arising out of the structure.

The result for the user was an increased ability to express core structure in relation to the particular problem.

Reflective analysis

Reflective Analysis is a technique for examining a manager's subject-referenced knowledge, referred to as a whole as core structure. The key difference between subject-referenced and object-referenced knowledge lies in its psychological function for the manager. Object-referenced knowledge is "pre-emptive" and has an exclusive function: if a project costs £10,000, it does not cost £50,000. Subject-referenced knowledge is "propositional" and has a relational function: if a project is risky, it is risky relative to other projects. In order to analyse subject-referenced knowledge therefore, the technique analyses patterns of experiencing and how they are different. This is operationalised in the programs by the use of continua on which the managers can place letters representing object-referenced pre-emptions of their experience in relative positions, in order to express subject-referenced meaning. (This process can best be expressed mathematically through Fuzzy Subset Theory (Kaufmann, 1975), the set of experiences to be related being the "Reference Set", the experiences themselves being the "elements", and the relative positions along the continua being the "Membership Functions".) The programs then calculate differences between the patterns, and feed them back to the managers in various forms.

The technique of analysing differences can be explained in a very simple way using paper and pencil. Returning to the example of the cars, the set of experiences being related can be identified as follows:

In the programs, the continuum is mapped onto a number range 0-99. If instead the number range is 1-6, then the concept "comfortable" can be expressed as follows:
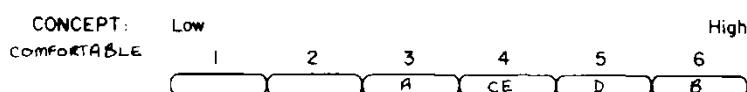
and similarly the concept "airy" can be expressed as:
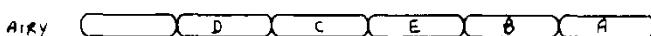
The measure of difference used is the "Mean Absolute Difference" (the Relative Generalised Hamming Distance in Fuzzy Subset Theory), which is calculated by averaging the absolute difference in experience positions along or across continua. Thus the difference between "comfortable" and "airy" is calculated as follows:

$$(|3 - 6| + |6 - 5| + |4 - 3| + |5 - 2| + |4 - 4|) \div 5 = 1.6.$$

The average distance between element positions over the two continua, and therefore the difference between the concepts, is 1.6 units, or $1.6 \div 6 = 27\%$ of the continua as a whole. The difference between "TR4A" and "CITROEN GS" is calculated in a similar way:

$$(|3 - 5| + |6 - 2|) \div 2 = 3.$$

The average difference between "TR4A" and "ClTROEN GS" being 3 units, or 3 ÷ 6 = 50% of the continua. The essential reason for using this measure of difference is therefore not just that it is transparent to the manager, but also because its meaning can be directly related by the manager back to the meanings which he was expressing on the original continua. This is a necessary condition for supporting reflective learning.

PAST REFLECTION

The process of Past Reflection has already been dealt with in some detail. Its purpose was to enable the manager to explore how he valued past experience which he felt was relevant to a current problem and its context. The program allows the manager to go on adding and deleting concepts and experiences until he is satisfied that he is reflecting on a whole.

```
MORE ALTERNATIVES?
?NO
FINISH?
?NO
DELETE CONCEPTS?
?NO
ADD CONCEPTS?
?NO
INVERT CONCEPTS?
?NO
DELETE EXPERIENCES?
?NO
ADD EXPERIENCES?
?NO
DATA LISTING?
?NO
EXPERIENCE DIFFERENCE?
?NO
CONCEPT SIMILARITY?
?NO
```

The capacity to invert concepts allows him to reverse the value implications of left-right on a continuum. Finally when he has finished, the program prints out its internal representation of the element positions on the continua, and allows him to delete his data if for whatever reason he does not wish to leave it in the computer.

```
FINISH?
?YES
```

```
1    TR4A
2    ROVER TC
3    FIAT 131
4    CITROEN GS
5    RENAULT 12
```

	1	2	3	4	5	
1	41	89	47	69	45	COMFORTABLE
2	93	47	61	69	53	COSTLY TO RUN
3	21	81	63	79	93	ROOMY
4	93	63	19	45	15	DIFFERENT
5	41	95	17	77	59	WELL FINISHED
6	49	35	43	9	79	EASY TO MAINTAIN
7	15	65	35	45	81	GOOD VALUE
8	39	53	29	19	73	ROBUST
9	27	63	47	53	75	FLEXIBLE
10	15	7	87	23	37	TINNY
11	49	91	19	63	39	WELL DESIGNED
12	99	79	55	21	35	POWERFUL
13	91	71	33	19	47	AIRY

```
DATA DELETED?
?NO
```

OPTION ANALYSIS

```
FORMS FOR REMOTE USE?
?NO
PAST REFLECTION?
?NO
OPTION ANALYSIS?
?YES
HP2640 TERMINAL?
?NO
```

Option Analysis enables the manager to consider how his concepts of value are influencing his view of the choices presently open to him for acting on a problem. This can be done with the concepts produced by Past Reflection, or as in this case with a subset of those concepts which the manager feels are particularly important.

```
OPTION ANALYSIS
***************

PLEASE ENTER IDENTITY CODE ? 4
DATA ON FILE?
?NO
DATA FROM PAST REFLECTION?
?NO
HOW MANY EVALUATIVE CONCEPTS?
?7
ENTER 7    20 CHARACTER LABELS FOR THEM
< QUALITY
< FAMILY
< SOUND
< BASIC
< EXTRAVAGANT
< SPORTY
< TINNY
HOW MANY OPTIONS ARE YOU CONSIDERING?
?5
ENTER 5    20 CHARACTER LABELS FOR THEM
< AUSTIN MAXI
< RENAULT 12
< CITROEN GS
< PEUGEOT 304
< FIAT 131
```

The manager can then evaluate each option in terms of each concept.

```
WHEN RATING THE ELEMENTS AGAINST EACH CONCEPT
USE LETTERS TO REPRESENT THE ELEMENTS AS FOLLOWS:
     a    AUSTIN MAXI          b - RENAULT 12
     c    CITROEN GS           d - PEUGEOT 304
     e    FIAT 131
```

```
                     LOW                                              HIGH
QUALITY              !----------------------------------------------------!
*****                ?     E        A     D     B            C

QUALITY              !-----e----------a-----d-----b----- -------c----------!
OK ? YES


FAMILY               !------------------e---d----------c-- ----a----- b----- !

SOUND                !---------c----e--a----------   d   --b---------- -----!

BASIC                !-------- --e----c---a----------- -d- ----b------ -- -- !

EXTRAVAGANT          !---------a----b--------------c--- -d- -----e---------- !

SPORTY               !--------ba---d-- --------c------ ---- -e--------------- !

TINNY                !----------------d--a--------c---b- ----e---------------!
```

From these evaluations the program can then analyse both which options are experienced as similar, and also which concepts express values which pattern the options in similar ways.

```
OPTION ANALYSIS?
?YES

OPTION GROUPINGS:
                                   +------------------* AUSTIN MAXI
                                 +-+
                                 |  +------------------* RENAULT 12
                          +------------------+
                          |                  |
                          |                  +------------------ * PEUGEOT 304
                 ---------+
                          |             +------------------ * CITROEN GS
                          +-----------------+
                                        +------------------* FIAT 131




SORT OPTION SEQUENCE?
?YES

CONCEPT GROUPINGS:
                                +------------------ ---- * QUALITY
                                |
                              +-+
                              | |               +---* SOUND
                              | +----------------|
                     +----------------+          +--- * BASIC
                     |          |
                     |          |
                     |          +------------------- ---* FAMILY
             --------+
                     |                   +---------- * EXTRAVAGANT
                     |               +----+
                     |               |    +----- ---* SPORTY
                     +--- - ----------------+
                                     |
                                     +------------------- * TINNY




SORT CONCEPT SEQUENCE?
?YES
```

From this analysis it can be seen that the Citroen and Fiat are a different kind of option to the other three cars; and that the concepts break into two main groups, one perhaps associated with a liking for speed, and the other with the need for a general purpose family car. The way in which the concepts are grouping the options can then be seen as a result of the sorting:

```
PATTERN ANALYSIS OF OPTION PREFERENCES:

   1     AUSTIN MAXI
   2     RENAULT 12
   3     PEUGEOT 304
   4     CITROEN GS
   5     FIAT 131


         1    2    3    4    5
   1     -    |    +   |++   --    QUALITY
   2          ||   +   |---   -    SOUND
   3     -    ||   +   |-    --    BASIC
   4     |    ||   -   |+    --    FAMILY
   5     --   -    +   | +   ++    EXTRAVAGANT
   6     --        -   | +   ++    SPORTY
   7     --   |    --  | +   ++    TINNY
```

The analysis shows that the -extravagant", "sporty" and "tinny" cars are the Citroen and Fiat, and that none of the other cars satisfy these values, whereas all the other cars do satisfy the general-purpose family car values.

```
FINISH?
?NO
DELETE OPTIONS?
?NO
ADD OPTIONS?
?NO
DELETE CONCEPTS?
?NO
ADD CONCEPTS?
?NO
INVERT CONCEPTS?
?NO
DATA LISTING?
?NO
OPTION ANALYSIS?
?NO
```

The manager can go on to consider trade-offs and weightings, adding and deleting concepts and options until he is satisfied that he understands exactly what he will gain and lose as a result of pursuing each option or group of options.

```
FINISH?
?YES

1    AUSTIN MAXI
2    RENAULT 12
3    CITROEN GS
4    PEUGEOT 304
5    FIAT 131


         1    2    3    4    5
1       33   55   79   45   11   QUALITY
2       75   89   59   39   31   FAMILY
3       33   73   17   63   27   SOUND
4       37   75   29   61   19   BASIC
5       17   27   51   61   79   EXTRAVAGANT
6       19   17   47   27   71   SPORTY
7       35   61   53   29   75   TINNY


DATA DELETED?
?NO
```

CONCEPT ANALOGIES

```
FORMS FOR REMOTE USE?
?NO
PAST REFLECTION?
?NO
OPTION ANALYSIS?
?NO
CONCEPT ANALOGIES?
?YES
HP2640 TERMINAL?
?NO
```

The manager may feel that he has got locked into a particular view of the problem, and that if he were able to talk it over with another manager, he might gain a different perspective. Concept Analogies supports this process, by allowing the manager with the problem to explain it to another manager so that the other manager can use his concepts for evaluating the options. Depending on the skill of the other manager in thinking analogously, his concepts will be more or less directly related to the problem. The importance for the manager with the problem however will be the process of thinking about his own problem through the other manager's eyes.

```
        CONCEPT ANALOGIES
        ******************

FLEASE ENTER IDENTITY CODE ? 4
DO YOU KNOW THE OTHER PERSON'S IDENTITY CODE?
?NO
HIS NUMBER IS OPPOSITE HIS NAME!
   1      RICHARD
   2      ANDREW
   3      CLODAGH
   4      PHILIP
ENTER HIS IDENTITY CODE:
?1
ARE YOU CONSIDERING YOUR OWN OPTIONS(1)
OR ANOTHER PERSON'S OPTIONS(2) ?
?1
DATA ON FILE?
?NO


ESTIMATE HOW THE OTHER PERSON HAS EVALUATED YOUR OPTIONS:
WHEN RATING THE ELEMENTS AGAINST EACH CONCEPT
USE LETTERS TO REPRESENT THE ELEMENTS AS FOLLOWS:-
            a    AUSTIN MAXI              b - RENAULT 12
            c    CITROEN GS               d - PEUGEOT 304
            e    FIAT 131


            LOW                                        HIGH
FUN         !----------------------------------------------!
XXXXX       ?         A       B       D      E          C

FUN         !-----------a---------b-------d------e----------c---!
OK ? Y


CAMPING     !----------------e---------d-a-b------c-----------!

ME          !---------a--d--e-----------------------b---c----------!

COMFORT     !-------------------d----b-----a----e-c----------!

STAID       !-------c------b-----e----------------d---------a----!

CHEAP TO RUN !------------------------e---------d----c-a--b--------!

LASTING     !------------------------e------d--------a-bc-------!

SOLID       !---------------c----e--d-----b------a-------------!

EASY TINKER !--------c------------d-e-------b---a-------------!
```
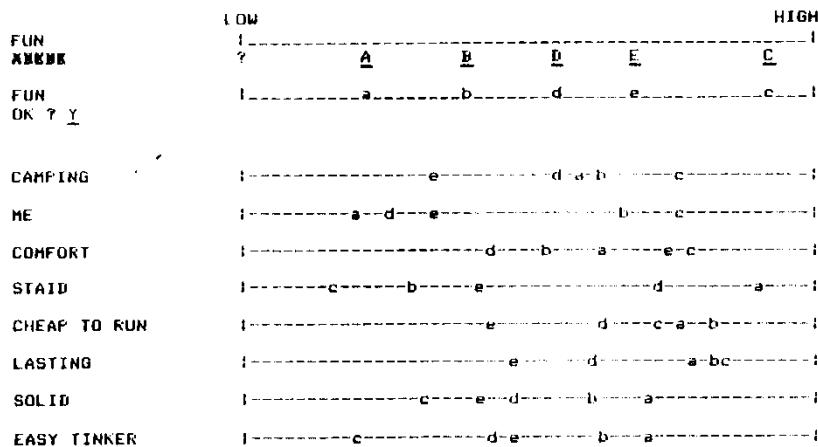
Assuming that the other manager has done his bit, then the manager with the problem will be able to use the program to analyse how close he has got to the other manager's point of view in trying to get outside his own.

```
        HAS THE OTHER PERSON EVALUATED YOUR OPTIONS?
        ?YES
        ANALYSIS OF ESTIMATES?
        ?YES


        % INACCURACY OF ESTIMATES (0=VERY GOOD):


                        FUN          ! 15
                        CAMPING      ! 20
                        ME           ! 22
                        COMFORT      ! 24
                        STAID        ! 48
                        CHEAP TO RUN ! 31
                        LASTING      ! 46
                        SOLID        ! 27
                        EASY TINKER  ! 24
```

He will also be able to examine how his use of the other manager's concepts (in brackets) relate to his own concepts.

```
COMPARISON WITH OWN CONCEPTS?
?YES

COMPARISON WITH YOUR OWN CONCEPTS:

                                        +-------------* FUN
                                        !
                        +------------+   !
                        !           !   !   +--------* (EXTRAVAGANT)
                        !           !   +----+
                        !           !       +--------* (SPORTY)
                        !           !
            +------+    !           !   +--------* CAMPING
            !      !    !           +-+
            !      !    !           ! +--------* (QUALITY)
            !      !    +------+    !
            !      !    !      !    +----------* ME
            !      !    !      !
            !      !    +----------+   +--------* COMFORT
            !      !           !   +------+
    ------------+  !           !       +--------* (TINNY)
            !      !           !
            !      !           !   +------------* STAID
            !      !           !   !
            !      !   +--------+  !   +---* SOLID
            !      !   !      ! +--------+
            !      !   !      ! !    +---* EASY TINKER
            !      !   !      ! !
            !      +-------+  ! !   +--* CHEAP TO RUN
                        !   +------+
                        !   ! !   +--* LASTING
                      +----------+
                      ! !  !
                      ! !  +--------* (FAMILY)
                    +-+
                      !       +--* (SOUND)
                    +----------------+
                              +--* (BASIC)
```
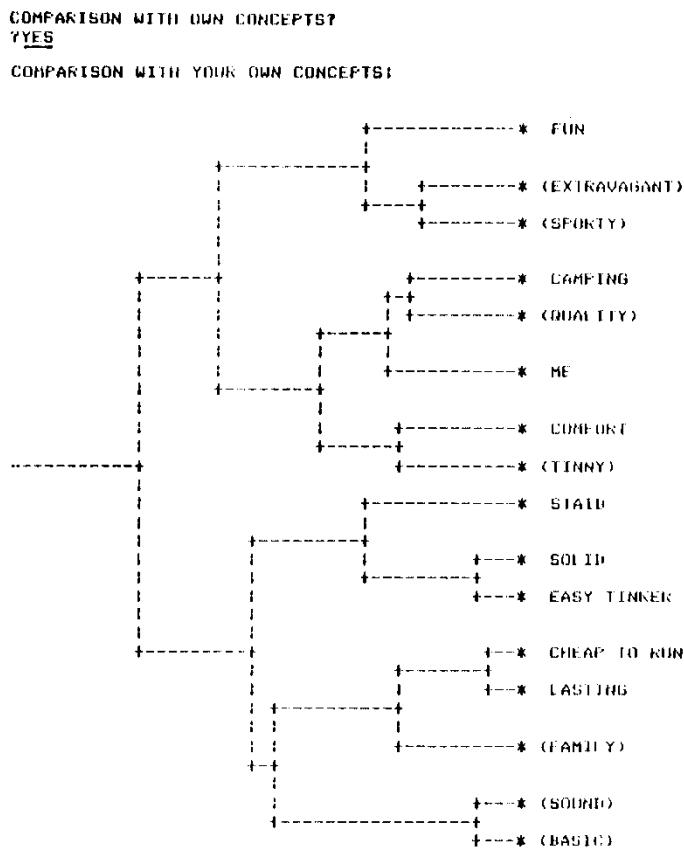
This analysis can enable him to work on understanding the other manager's view and then to go back to Option Analysis to incorporate any new concepts which may have come to mind as a result of the process.

```
ALTERNATIVES?
?YES
LATERAL GROUPING?
?NO
GROUPING IGNORING SCALING?
?NO
MORE ALTERNATIVES?
?NO

FINISH?
?NO
MODIFY ESTIMATES?
?NO
DATA LISTING?
?NO
ANALYSIS OF ESTIMATES?
?NO
GROUPING OF ESTIMATES WITH HIS ACTUAL EVALUATIONS?
?NO
COMPARISON WITH OWN CONCEPTS?
?NO

DATA DELETED?
?NO

FINISH?
?YES

1     AUSTIN MAXI
2     RENAULT 12
3     CITROEN GS
4     PEUGEOT 304
5     FIAT 131

      1    2    3    4    5

1    19   37   91   53   67   FUN
2    59   63   77   55   33   CAMPING
3    19   67   77   25   33   ME
4    63   53   79   43   75   COMFORT
5    91   29   15   73   41   STAID
6    77   83   73   63   43   CHEAP TO RUN
7    79   83   85   61   47   LASTING
8    71   51   30   46   40   SOLID
9    71   63   18   42   46   EASY TINKER

DATA DELETED?
?NO
```

ROLE NETWORK ANALYSIS

```
FORMS FOR REMOTE USE?
?NO
FAST REFLECTION?
?NO
OPTION ANALYSIS?
?NO
CONCEPT ANALOGIES?
?NO
ROLE NETWORK ANALYSIS?
?YES
HP2640 TERMINAL?
?NO
```

So far programs have been described which help the individual manager to know his own value perspective as clearly as possible. The process of Consensus Generation assumes that a group of managers are interdependent: any action taken by any one of them will affect or constrain the actions open to any other. Role Network Analysis provides a means of examining the diversity of perspective and the extent to which each manager appreciates that diversity. To do this a set of options are needed which can form a benchmark for the analysis.

```
ROLE NETWORK ANALYSIS
*********************
```

```
FILES SET UP?
?NO
ARE YOU SURE!
?YES
HOW MANY PEOPLE IN NETWORK?
?4
ENTER A 20 CHARACTER NAME FOR EACH OF THE 4    PEOPLE
< RICHARD
< ANDREW
< CLODAGH
< PHILIP
HOW MANY OPTIONS?
?6
ENTER 4    20 CHARACTER LABELS FOR THEM
< RENAULT 12
< RENAULT 14
< CITROEN GS
< AUSTIN MAXI
< PEUGEOT 304
< FIAT 131
DO YOU KNOW YOUR IDENTITY NUMBER?
?NO
YOUR NUMBER IS OPPOSITE YOUR NAME!
   1      RICHARD
   2      ANDREW
   3      CLODAGH
   4      PHILIP
PLEASE ENTER IDENTITY CODE ? 4
DATA ON FILE?
?NO
```

Each manager estimates the preferences each other manager has for the options,

```
OPPOSITE YOUR OWN NAME RATE YOUR PREFERENCES FOR
THE OPTIONS; AND OPPOSITE THE OTHERS' NAMES, ESTIMATE
THE OTHERS' PREFERENCES.


WHEN RATING THE ELEMENTS AGAINST EACH CONCEPT
USE LETTERS TO REPRESENT THE ELEMENTS AS FOLLOWS:
        a    RENAULT 12              b - RENAULT 11
        c    CITROEN GS              d - AUSTIN MAXI
        e    PEUGEOT 304             f - FIAT 131
```

```
                    LOW                                      HIGH
RICHARD             !_____!
ANSWER              ?       D     F  A E          B            C

RICHARD             !_____d_____f__a_e_____b_____c_____!
OK ? YES
```

```
                    LOW                                      HIGH
ANDREW              !_____!
ANSWER              ?       A   D   C     D   E        F

ANDREW              !_____a___d___c_____b___e_____f_____!
OK ? Y
```

```
                    LOW                                      HIGH
CLODAGH             !_____!
ANSWER              ?     DA      F      D    C      E

CLODAGH             !_____da_____f_____b_____c_____e_____!
OK ? Y
```
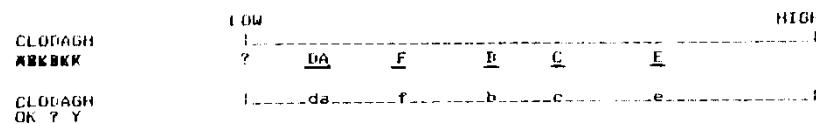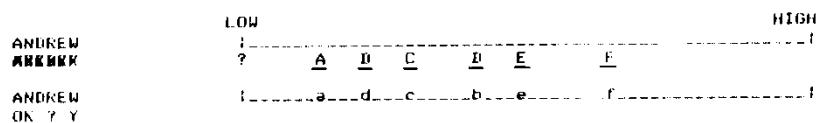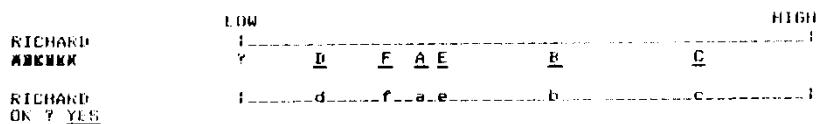
and also defines his own preferences:

```
                    LOW                                      HIGH
PHILIP              !_____!
ANSWER              ?  D       B    E    F    C    A

PHILIP              !__d_____b_____e_____f____C___a_____!
OK ? NO              ?       D

PHILIP              !_____d_____b_____e_____f___C____a_____!
OK ? YES
```
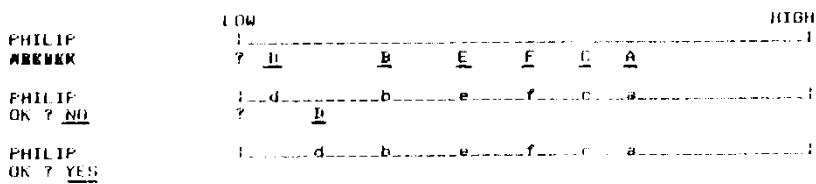
From this data the program can then analyse which managers' actual views are
similar, and the extent to which each manager's views are different from each other
manager.

```
DATA ANALYSIS?
?YES
ON EVERYONE IN NETWORK?
?YES


        ANALYSIS OF ACTUAL PREFERENCES:

ACTUAL SIMILARITIES BETWEEN PEOPLE IN NETWORK:

                          +--------------------------- *   RICHARD
            +------------------+
            |                  +------------------------ *   ANDREW
       -------+
            |           +------------------------------- *   CLODAGH
            +----------+
                        +------------------------------- *   PHILIP



        ACTUAL DIFFERENCES BETWEEN THEIR POINTS OF VIEW:



            a -- RICHARD                  b    ANDREW
            c -- CLODAGH                  d    PHILIP


                    LOW                                      HIGH

    RICHARD         !a----------b-d----c--------              .            :

    ANDREW          !b----------a-------c-d-----              .          . :

    CLODAGH         !c-------------d--ab----  ...             .             :

    PHILIP          !d-----------a-c----b  ...                .             :
```
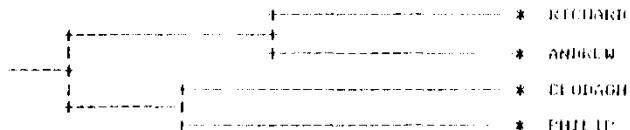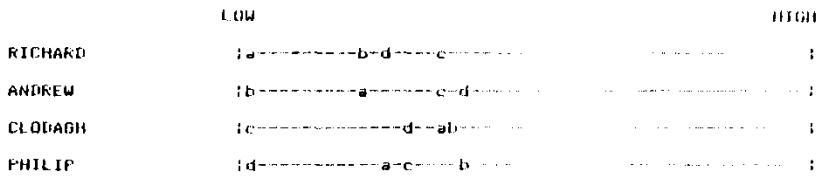
This analysis can provide important insights into the degree of difference which the group will have to come to terms with if it is to arrive at a consensus view. It is important to realise however that any consensus will have to be arrived at not by removing the differences, but rather by finding ways of understanding and working with the differences. The second part of the analysis provides each manager with an assessment of how accurately he has estimated the others' views.

```
        ANALYSIS OF ESTIMATES?
        ?YES



        YOUR ESTIMATE OF THEIR SIMILARITIES :

                        +------------------------------* RICHARD
            +--------      ----+
            !                  +----------------------------* CLODAGH
       ------+
            ! +        ...  -------------------------------* ANDREW
            +---+
                +   ...  -------------------------------* PHILIP

        % INACCURACY OF YOUR ESTIMATES (O=VERY GOOD):

                    RICHARD          : 16
                    ANDREW           : 36
                    CLODAGH          : 20
                    PHILIP           : 0
```

This both can show how the manager thinks people are grouped, and also can give him some measure of who he misunderstands the most. Assuming that the other managers have also worked on their respective value perspectives reflectively, then this analysis can indicate who to work with in Exchanging Views.

```
FINISH?
?NO
MODIFY ESTIMATES?
?NO
DATA LISTING?
?NO
DATA ANALYSIS?
?NO

FINISH?
?YES
```

```
1    RENAULT 12
2    RENAULT 14
3    CITROEN GS
4    AUSTIN MAXI
5    PEUGEOT 304
6    FIAT 131
```

```
         1    2    3    4    5    6

1       31   55   01   13   35   25    RICHARD
2       13   41   29   21   49   65    ANDREW
3       13   43   55   11   73   27    CLODAGH
4       69   25   61   13   39   51    PHILIP
```

```
DATA DELETED?
?NO
```

EXCHANGING VIEWS

```
FORMS FOR REMOTE USE?
?NO
PAST REFLECTION?
?NO
OPTION ANALYSIS?
?NO
CONCEPT ANALOGIES?
?NO
ROLE NETWORK ANALYSIS?
?NO
EXCHANGING VIEWS?
?YES
HP2640 TERMINAL?
?NO
```

Exchanging Views can provide a means of exploring how another manager evaluates options common to both managers, and of providing a detailed analysis of how the views are different.

```
              EXCHANGING VIEWS
              *******************

     PLEASE ENTER IDENTITY CODE ? 4
     DO YOU KNOW THE OTHER PERSON'S IDENTITY CODE?
     ?NO
     HIS NUMBER IS OPPOSITE HIS NAME:
        1     RICHARD
        2     ANDREW
        3     CLODAGH
        4     PHILIP
     ENTER HIS IDENTITY CODE:
     ?1
     DATA ON FILE?
     ?NO
     THESE ARE YOUR OWN OPTIONS:
        1     AUSTIN MAXI
        2     RENAULT 12
        3     CITROEN GS
        4     PEUGEOT 304
        5     FIAT 131
     AND THESE ARE THE OTHER PERSON'S OPTIONS:
        1     MAXI
        2     REN 12
        3     REN 14
        4     CIT GS
        5     PEU 304
        6     DYANE
     ENTER THE NUMBERS OF THE OPTIONS OF THE OTHER PERSON WHICH
     YOU WANT TO USE FOR ESTIMATING (ONE PER LINE, 0=FINISH)
     ?1
     ?2
     ?4
     ?5
     ?0
        1     MAXI
        2     REN 12
        3     CIT GS
        4     PEU 304
     ARE THEY CORRECT?
     ?YES
```

The manager chose to exchange views with Richard, although his misunderstanding of Andrew's views was greater. To do this he estimated how the other manager used his concepts.

```
NOW ESTIMATE THE OTHER PERSON'S PREFERENCES
WHEN RATING THE ELEMENTS AGAINST EACH CONCEPT
USE LETTERS TO REPRESENT THE ELEMENTS AS FOLLOWS:
          a - MAXI               b - REN 12
          c - CIT GS             d - PEU 304

                  LOW                                        HIGH
FUN               !_____  _____ _ :
ABEM              ?    A          D  B                        C

FUN               !____a_____d__b_____ ___ __ _____c_____ :
OK ? YES


CAMPING           !_____d__a____  __    b _____c____ :

ME                !__a____b_____ d__        ___c_____ _ :

COMFORT           !_____a___b____    _d _  __ c___ __ _ :

STAID             !_____ ___c_____d___      b__ _a__ __:

CHEAP TO RUN      !___ ___a_____c___ d         _____b___ :

LASTING           !_ __ ___a_____d___ b   __ ___c_____ :

SOLID             !___ __ _c_____b__ _ d    d_____ :

EASY TINKER       !__ c_____     __d   _   _b____ _:
```
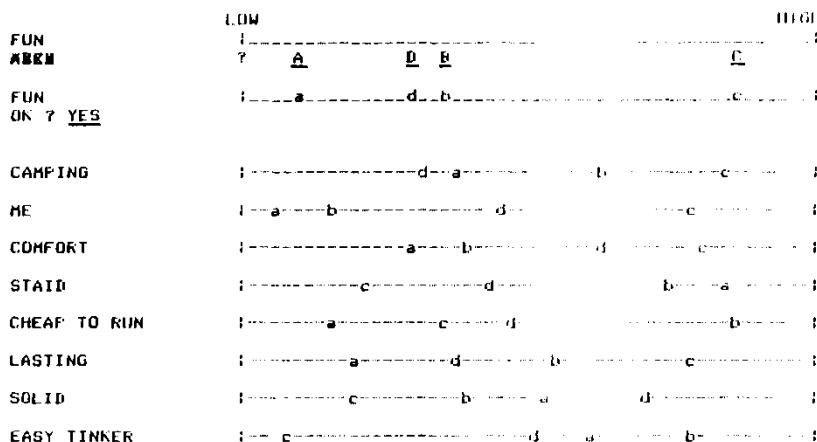
On the basis of these estimates, the program can analyse the accuracy with which the manager has estimated each concept.

```
ANALYSIS OF ESTIMATES?
?YES
```

```
% INNACURACY OF YOUR ESTIMATES (0=VERY GOOD):
```

```
FUN              : 17
CAMPING          : 14
ME               : 6
COMFORT          : 20
STAID            : 13
CHEAP TO RUN     : 14
LASTING          : 12
SOLID            : 26
EASY TINKER      : 9
```

The numbers indicate which concepts have been most misunderstood. The program can also show the manager how his estimates relate to the other manager's actual use of his concepts:

```
GROUPING OF ESTIMATES WITH HIS ACTUAL PREFERENCES?
?YES
```

```
ESTIMATED AND ACTUAL PREFERENCE GROUPINGS:
```
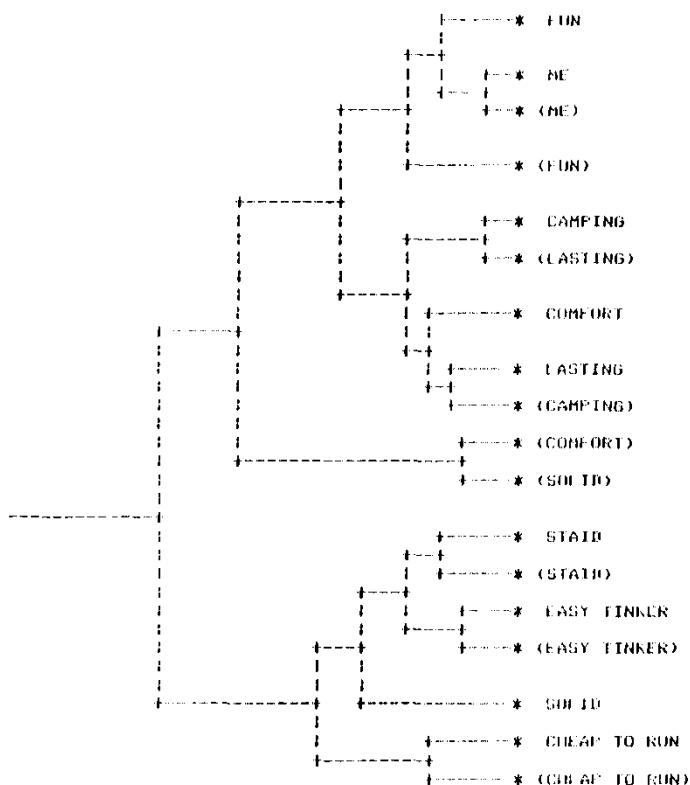

Richard's actual concepts are in brackets, and the manager's estimates using his concepts are not. This information can provide additional insights into how the manager is missing the other's point of view. Dealing with these misunderstandings enables the manager to gain an understanding of the other's view which takes him beyond his own. By then relating those new concepts back to his own, the manager can begin to develop a language for expressing how their different views relate.

```
COMPARISON WITH OWN CONCEPTS?
?YES
THESE ARE THE OPTIONS YOU USED FOR ESTIMATION:
  1     MAXI
  2     REN 12
  3     CIT GS
  4     PEU 304
THESE ARE YOUR OWN OPTIONS:
  1     AUSTIN MAXI
  2     RENAULT 12
  3     CITROEN GS
  4     PEUGEOT 304
  5     FIAT 131
ENTER THE NUMBERS OF YOUR OWN OPTIONS WHICH CORRESPOND
TO THE ONES USED FOR ESTIMATION. (ONE PER LINE 0=FINISH)
?1
?2
?3
?4
?0
  1     AUSTIN MAXI
  2     RENAULT 12
  3     CITROEN GS
  4     PEUGEOT 304
ARE THEY CORRECT?
?YES
```

```
COMPARISON WITH YOUR OWN CONCEPTS:
```

```
( 5) (SOUND)          AND (BASIC)          ... A[ PRACTICAL      ]
( 5) LASTING          AND (QUALITY)        -- B[ QUALITY         ]
( 9) CAMPING          AND (TINNY)          -- C[ UTILITARIAN     ]
(12) FUN              AND ME               -- D[ FEELS GOOD      ]
(12) STAID            AND EASY TINKER      -- E[ TRADITIONAL     ]
(12) (EXTRAVAGANT)    AND (SPORTY)         -- F[ EXTRAVAGANT     ]
(13) COMFORT          AND B[ QUALITY    ]  -- G[ LUXURIOUS       ]
(16) CHEAP TO RUN     AND A[ PRACTICAL  ]  -- H[ GOOD VALUE      ]
(17) D[ FEELS GOOD ]  AND G[ LUXURIOUS ]   -- I[ IDEAL          ]
(22) E[ TRADITIONAL ] AND (FAMILY)         -- J[ SAFE BET        ]
(25) I[ IDEAL      ]  AND F[ EXTRAVAGANT ] -- K[ ——             ]
(28) C[ UTILITARIAN ] AND H[ GOOD VALUE ]  -- L[ SENSIBLE        ]
(34) L[ SENSIBLE   ]  AND J[ SAFE BET   ]  -- M[ ——             ]
(36) M[            ]  AND SOLID            -- N[ ——             ]
```

Again the manager can work through the concepts reflectively, relating the individual concepts to the structure as a whole, so that the two managers have some basis for discussing what form an option commanding consensus support might take.
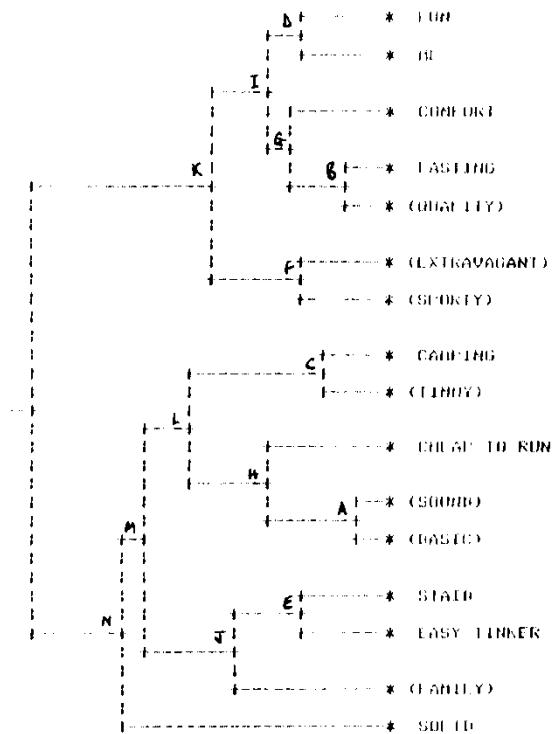
```
ALTERNATIVES?
?YES
LATERAL GROUPING?
?NO
GROUPING IGNORING SCALING?
?NO
MORE ALTERNATIVES?
?NO

FINISH?
?YES

1    MAXI
2    REN 12
3    CIT GS
4    PEU 304

        1    2    3    4

1       9   35   87   29   FUN
2      37   63   85   31   CAMPING
3       5   15   79   45   ME
4      29   39   81   63   COMFORT
5      85   75   21   43   STAID
6      15   87   35   47   CHEAP TO RUN
7      19   55   79   37   LASTING
8      53   39   19   71   SOLID
9      61   79    7   51   EASY TINKER

YOUR CORRESPONDING OPTIONS WERE:
1    AUSTIN MAXI
2    RENAULT 12
3    CITROEN GS
4    PEUGEOT 304

DATA DELETION?
?NO
```

CONSENSUS GROUPING

```
FORMS FOR REMOTE USE?
?NO
FAST REFLECTION?
?NO
OPTION ANALYSIS?
?NO
CONCEPT ANALOGIES?
?NO
ROLE NETWORK ANALYSIS?
?NO
EXCHANGING VIEWS?
?NO
CONSENSUS GROUPING?
?YES
HP2640 TERMINAL?
?NO
```

At the end of a process of Consensus Generation, a group of managers will have developed a language for discussing how their different views relate to each other. This will not have removed the differences, but will have given the managers a way of working with their differences. Consensus Grouping like Option Analysis is concerned with exploring the trade-offs between those differences when different courses of action are considered. The courses of action may be represented by one or more options, but taken together, they will represent different strategies for dealing with the problem, assuming that there is some feasible way of implementing the options. It is for this reason that these processes of Consensus Grouping and Option Analysis are referred to as Strategic Design.

```
                    CONSENSUS GROUPING
                    *******************

         PLEASE ENTER IDENTITY CODE ? 4
         DATA ON FILE?
         ?NO
         THESE ARE THE PEOPLE IN THE NETWORK:
           1     RICHARD
           2     ANDREW
           3     CLODAGH
           4     PHILIP
         THE OPTIONS USED BY THE FOLLOWING PEOPLE ARE:
         PERSON 1     :
           1     MAXI
           2     REN 12
           3     REN 14
           4     CIT GS
           5     PEU 304
           6     DYANE
         PERSON 2     :
         PERSON 3     :
         PERSON 4     :
           1     AUSTIN MAXI
           2     RENAULT 12
           3     CITROEN GS
           4     PEUGEOT 304
           5     FIAT 131
         DECIDE WHICH PEOPLE YOU WANT TO INCLUDE IN THE
         CONSENSUS GROUPING, AND CHOOSE OPTIONS WHICH ARE
         COMMON TO ALL OF THEM.   HOW MANY OPTIONS?
         ?4
         ENTER 4     20 CHARACTER LABELS FOR THEM(ONE PER LINE)
         < MAXI
         < REN 12
         < CIT GS
         < PEU 304


         WHOSE CONCEPTS DO YOU WANT TO TRANSFER? (0=NO MORE)
         ?1
         ENTER THE NUMBERS OF THE OTHER PERSON'S OPTIONS WHICH
         CORRESPOND TO THE ONES IN THE COMMON SET;
         (ONE PER LINE 0=FINISH)
         ?1
         ?2
         ?4
         ?5
         ?0
           1     MAXI
           2     REN 12
           3     CIT GS
           4     PEU 304
         ARE THEY CORRECT?
         ?YES
         THESE ARE HIS CONCEPTS:
           1     FUN
           2     CAMPING
           3     ME
           4     COMFORT
           5     STAID
           6     CHEAP TO RUN
           7     LASTING
           8     SOLID
           9     EASY TINKER
         DO YOU WANT TO TRANSFER ALL OF THEM?
         ?YES


         WHOSE CONCEPTS DO YOU WANT TO TRANSFER? (0=NO MORE)
         ?4
         ENTER THE NUMBERS OF THE OTHER PERSON'S OPTIONS WHICH
         CORRESPOND TO THE ONES IN THE COMMON SET;
         (ONE PER LINE 0=FINISH)
         ?1
         ?2
         ?3
         ?4
         ?0
           1     AUSTIN MAXI
           2     RENAULT 12
           3     CITROEN GS
           4     PEUGEOT 304
         ARE THEY CORRECT?
         ?YES
         THESE ARE HIS CONCEPTS:
           1     QUALITY
           2     FAMILY
           3     SOUND
           4     BASIC
           5     EXTRAVAGANT
           6     SPORTY
           7     TINNY
         DO YOU WANT TO TRANSFER ALL OF THEM?
         ?YES
```

The analysis which can be done is identical to Option Analysis, so that the options and concepts can again be grouped, and the relationship between the two explored:

```
WHOSE CONCEPTS DO YOU WANT TO TRANSFER? (0-NO MORE)
?0
CONSENSUS GROUPING?
?YES

CATEGORIES OF OPTION:
                                    +--------------- *  MAXI
                                    I
            +----------------+      I
            I                I      I +--------------- *  KLM 12
            I                I      +-+
    -------+                I      +--------------- *  PEU 304
            I
            I
            +--------------------------------------------- *  CIT GS

    SORT OPTION SEQUENCE?
    ?YES


CATEGORIES OF CONCEPT:
                                        +-*  FUN
                                  +------+
                                  I     +-*  SPORTY
                               +-+
                               I I
                    +--------+ +----------*  EXTRAVAGANT
                    I        I
                    I        +---------*  ME
                    I
                    I
    +--------------+      +--*  CAMPING
    I              I      +----+
    I              I      I    +--*  QUALITY
    I              I      +-+
    I              I      I I
    I              +--------+ +--------*  TINNY
    I              I
    I              +---------*  LASTING
    I
    I                        +-----*  COMFORT
    I              +----------+
    I              I         +--- *  SOLID
    I        +--------+
    I        I       I
    I        I       +--------------*  FAMILY
    I        I
    I    +---+       +------*  STAID
    I    I         +-------+
    I    I         I      +------*  EASY TINKER
    I    I         I
    +-----------+         +------*  CHEAP TO RUN
             I           I
             +-------+    I  +--*  SOUND
                     I    +--+
                     +--*  BASIC


    SORT CONCEPT SEQUENCE?
    ?YES
```

```
PATTERN ANALYSIS OF THE COLLECTED OPTION PREFERENCES:

1    MAXI
2    REN 12
3    PEU 304
4    CIT GS


         1   2   3   4

1        -   -   +  | ++    FUN
2        --  --     | ++    SPORTY
3        --  -   ++ | +     EXTRAVAGANT
4        -   --  +  | ++    ME
5        --  +   -- | ++    CAMPING
6        --  +   -- | ++    QUALITY
7        -   ++  ---| +     TINNY
8        -   +   --- | ++   LASTING
9        +   --  -- | ++    COMFORT
10       +   --  -  | ++    SOLID
11       +   ++  ---|  --   FAMILY
12       +   +   +  | --    STAID
13       +   +   +  | -     EASY TINKER
14       --  +   +  | -     CHEAP TO RUN
15       -   ++  +  | ---   SOUND
16       -   ++  +  | -     BASIC
```

This analysis only shows two managers' views combined. Adding the other two's views might make the trade-offs more polarised, or create new possibilities for compromise, but the Consensus Grouping would always represent a picture of the trade-offs between the managers. At one extreme it might show options which everyone valued; or at the other how the gains of one group of managers would be the losses of another. Either way, its usefulness lies in the purchase it can give individual managers on what trade-offs have to be negotiated between them, and where new options need to be created in order to create a basis for compromise. The technique is therefore a means of securing more effective action, by providing support for a process of integrative bargaining (Walton & McKersie, 1966).

```
FINISH?
?NO
CONSENSUS GROUPING?
?NO
DELETE CONCEPTS?
?NO
DELETE OPTIONS?
?NO
ADD OPTIONS?
?NO
ADD MORE CONCEPTS?
?NO
DATA LISTING?
?NO

     FINISH?
     ?YES

1     MAXI
2     REN 12
3     CIT GS
4     PEU 304

          1    2    3    4

1        15   17   43   29    FUN
2        31   51   67   49    CAMPING
3        15   17   89   43    ME
4        77   27   91   53    COMFORT
5        81   85   31   71    STAID
6        23   63   41   65    CHEAP TO RUN
7        39   53   89   23    LASTING
8        79   45   89   69    SOLID
9        67   77    9   75    EASY TINKER
10       33   55   79   45    QUALITY
11       75   89   59   39    FAMILY
12       33   73   17   63    SOUND
13       37   75   29   61    BASIC
14       17   27   51   61    EXTRAVAGANT
15       19   17   47   27    SPORTY
16       35   61   53   29    TINNY


DATA DELETED?
?NO
```

```
FINISH?
?NO
PAST REFLECTION?
?NO
OPTION ANALYSIS?
?NO
CONCEPT ANALOGIES?
?NO
ROLE NETWORK ANALYSIS?
?NO
EXCHANGING VIEWS?
?NO
CONSENSUS GROUPING?
?NO
FINISH?
?YES

DONE
```

This section has shown how the technique of Reflective Analysis can be used to explore subject-referenced knowledge in relation to a particular problem and its context. One assumption which has been made throughout about the problem itself is that there do exist clear options. There is no reason why this should be the case, since the problem and its context are quite likely to be as undefined as the manager's awareness of his own values. The method of structural analysis (Boxer, 1979) complements Reflective Analysis since it enables managers to analyse and experience how actions taken in their task environment will interact with each other. This process would thus be one way of clarifying options in the task environment. Such a process must necessarily complement any use of Reflective Analysis with the manager if the manager is to produce benefit for his organisation as well as for himself.

Conclusion

The software developed by the Management Decision-making Project and referred to as "NIPPER" defined a programming language useful in supporting reflective learning. The six programs described in this paper were developed by the author for a particular purpose, and as such represent only one out of an unlimited number of ways of using "NIPPER" (Boot, 1979). The programs were developed for managers likely to have the greatest difficulty in keeping espoused theories and theories-in-use congruent: managers in complex organisations who are concerned with managing structural change, and who work with a high degree of functional specialisation and interdependency in their organisation's activities. Such managers are likely to have such difficulty because the nature of their organisation forces them to act so much through their use of language rather than to act directly on the task environment.

The theory underlying the use of this method explains why the manager is likely to have difficulty expressing concepts of value and relatedness: the structure implicit in his use of language is heavily biased towards the expression of object-referenced knowledge. Through its tendency towards pre-emptiveness and exclusivity therefore, his language makes it difficult for the manager to talk about context and the value of his past experience. The theory points towards the need for a change in the way managers use language so that such meanings can more easily be expressed. This paper describes one way of enabling managers to learn to make that change: when they choose. The method described in this paper therefore enables the manager to learn not only to value his own experience, but more importantly, to be able to express that value to others. It does so by providing a means of talking not only about the content of his experience, but also about how he experiences it in relation to other experiences. Such a learning is a powerful tool which a manager can in a very real sense use to manage his own learning.

The analysis underlying the method is very simple, and much could be done to extend both its power and applicability so that the method could be made more conversational and the analysis able to deal with structures of concepts. Such a development would make the method more immediately accessible to greater numbers of managers, particularly if implemented cheaply on a desk-top microcomputer. Throughout this paper, the method has been talked about in relation to managers' activities. As a tool for enabling greater effectiveness in the process of strategic management it could perhaps have large impact on the structural ossification of his society. In the long run, however, its importance will be as a practical way both of developing people's sensitivity to the possibility of change, and also of developing their capacity for learning.

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