Aids for Customizing Generic System Dynamics Models: A Community Development Example

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ABSTRACT

The general considerations for the development and customization of a generic system dynamics model for rural community development are presented. A preliminary version of a generic model is presented. Alternative customization strategies based on problem complexity as perceived by the community are discussed. The customization involves generating a network representation of the problem using a modified version of interpretive structural modeling and a pattern transfer procedure to enhance the generic model. The entire procedure is based on cognitive criteria to overcome human information processing limitations; to provide a rational and systematic approach to the simplification of problem complexity, and to promote a shared understanding of the problem situation among the participants.

BACKGROUND

The integration of the scientific-rational and the social-consensual dimensions into planning is a major challenge in community development today. It is now recognized that social and economic issues should be addressed together with the issues on environmental and visual-aesthetic quality. The complex, time-dependent interrelations and interactions among all these issues should be analyzed by incorporating the knowledge and insights made available by more than one discipline. Since there are no widely accepted general theories of socio-economic change and spatial development, community planning has been largely based on partial analytic models with restrictive assumptions regarding system behavior. The model outcomes are then interpreted using expert judgement in making recommendations on the problem issues.

The social-consensual dimension requires that the local capabilities within a problem context be mobilized to initiate and sustain planning efforts through genuine participation of the inhabitants and of the public and private agencies. This requirement provides the community members with means to exercise control over their environment and facilitate adaptation to growth and change. It is expected that such a strategy will maintain continuity in the environment so as to establish a "planning culture" (Skinner 1953), allowing adaptive responses to occur at the local level (Dunn 1971, Smith 1973).

The underlying theme of a planning approach to respond to both of the above challenges is the notion of an "appreciative system," consisting of a group, an institution or an organization charged with policy making. In this context appreciation involves making judgements about the external and internal state of the system, and about the significance of these judgements. The appreciative judgement reflects the views currently held by those who make them, describes which events and relations they will regard as relevant under various conditions, and how they value these. Such judgements disclose what can best be described as a "readiness" to distinguish certain aspects of a situation from others and to classify and evaluate them in a particular way. This state of readiness is described as an "appreciative system". It needs to be learned much like other perceptual schemata (Vickers 1965).

The perception of a problem situation in the community development context may take the form of internalized or externalized models. Appreciation, however, refers to the achievement of a special kind of perception which is 1) shared by the planning group - including the experts and lay people, 2) reflects those characteristics of the problem situation perceived to be important by them, and 3) represents the collective knowledge about the situation rather than only those deemed "necessary and sufficient" by the experts. Therefore, the formulation of appreciative judgement starts with each individual's mental model, and ends with an external model containing the facts and values which bear on the decisions. The processes leading to the appreciation are cognitive and deal with perception and integration of information at the individual and group levels.

In this paper we describe the main components of a decision support system for community development which enhances the appreciative capabilities of the policy making groups by aiding them in the effective use of available expert knowledge and integration of relevant information to analyze their own problems, to formulate policy options and to evaluate available alternatives for the resolution of these problems. These components consist of 1) a generic community development model, 2) a problem structuring algorithm, and 3) a situational system dynamics model. In the following sections, the larger procedural framework will be discussed first. Then the details of the three components will be described.

THE METHODOLOGY

The three components of the decision support system are based on a larger procedural framework developed by Checkland (1981) and referred to as a generalized "soft" systems methodology for resolving unstructured problems. This methodology is a result of the reflective approach taken by Checkland in his industrial engineering problem-solving practice, and basically represents the refinements of departure from the "hard" systems thinking which was widely employed in the late 1960s and in the 1970s. Figure 1 is taken from Checkland (1981; p. 163) and is modified to serve as the basis to develop the specifics of an approach to community problem solving. The methodology contains two kinds of activity. The stages above the dotted line in Figure 1 are the "real-world" activities. Those below the dotted line are "systems thinking" activities. It is by these two activities that the real-world complexity is structured. In this study the structuring is achieved via the generation, use and modification of externalized models.

In stages 1 and 2 an attempt is make to build the richest possible picture of th problem situation. In these stages divergent cognitive processes are encouraged via the application of group idea generation procedures such as brainstorming (Rickards 1982) or the nominal group technique (Gill and Delbecq 1982). Stages 3 and 4a represent the ideas generated in the previous stages. The outcome is the model of the situation as perceived by the participants.

Among a large number of structural modeling techniques (Martino 1972), Interpretive Structural Modeling (ISM) addresses precisely the same scientific-rational and social-consensual issues and objectives as described earlier. The objectives and advantages of the method have been presented in

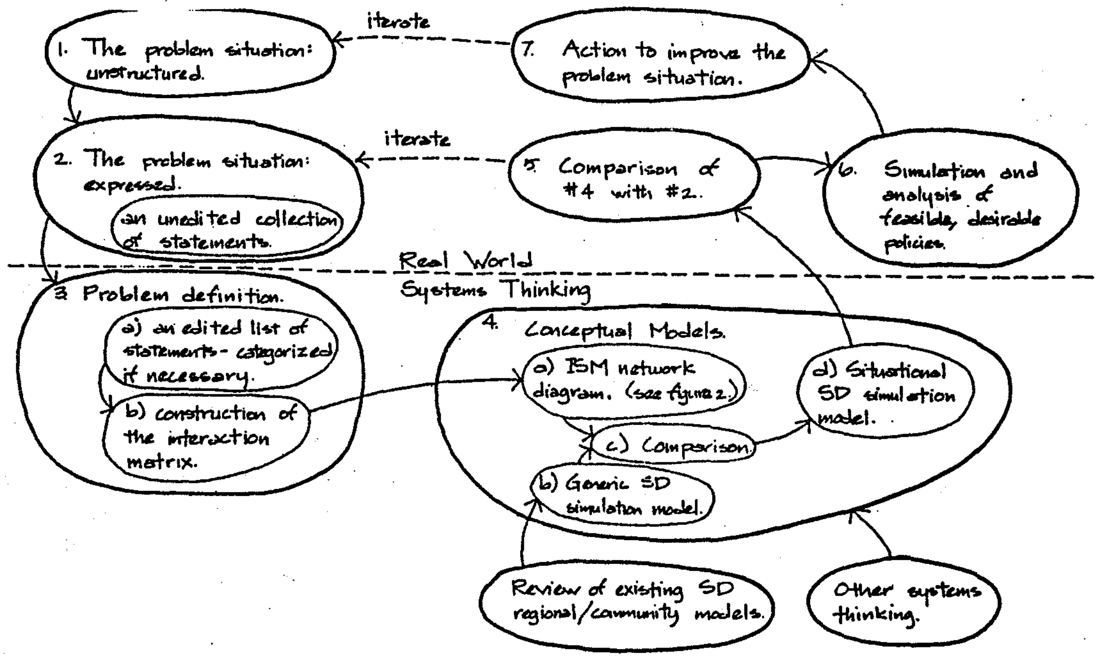

Figure 1

detail elsewhere (Warfield 1976, Watson 1978). It has also been applied in problem contexts such as priority setting in urban systems management (Waller 1975), analysis of public safety in a neighborhood (Fitz 1975), and analyzing urban development (Malone 1975). It has also been suggested that the technique be integrated with simulation modeling to achieve rigor in designing the model structure (Burns 1975). The method still has some unresolved issues in application such as the difficulty of incorporating minority views and eliminating effects of group dynamics or pressure on the final conceptualization (Watson 1978).

In the framework presented here, the main function of the ISM technique is to generate the richest picture of the situation reflecting the variety of perceptions and interests, beliefs and interpretations of available information regarding variables and interrelationships without imposing any preconceived structure. The procedural guidelines and the algorithms used in stages 2 through 4a comprise the first component of the decision support system. Stage 4b is the second component of the proposed approach consisting of a generic system dynamics community model, providing the widely accepted expert knowledge about the structure and behavior of community subsystems. The advantages of the system dynamics type simulation modeling in this context (Sancar 1977), and the value of designing and using generic models have been discussed elsewhere (Forrester, 1961). Here the main purpose of the generic model is to provide the problem solving group with a menu of conceptualizations which reflect an understanding of systems potentially relevant to community development issues.

The situational system dynamics model in stage 4d, represents the completion of the model externalization process. This model is constructed via a customization procedure involving the integration of the initial structural model of stage 4a with the generic model of stage 4b through comparison and specification. The evaluation of the situational model takes place in stage 5. If the model is found to reflect a collective appreciation of the situation, the process moves forward. If not, any combination of stages 2 through 5 may be repeated. Stage 6 involves the analysis of those scenarios deemed important, desirable, or feasible by the participant group. Action to improve the problem situation may then be taken with the aid of the information and understanding obtained through the application of the entire methodology (Stage 7). In turn, the methodology may be continuously reiterated if problems or issues continue to emerge.

Within this methodological framework, the three components of a decision support system mentioned earlier in the introduction are perceived as aids for information processing and social interaction while reducing the biases inherent in human cognition processes. In the long run, using these procedures will result in accumulation of knowledge on the community systems since the problem/decision context and its activities will be documented in detail as part of the process. An enhanced understanding of the problem will then be reflected from commonalities observed in a number of situational models. In the following, the development of the generic community model and its customization will be presented.

THE GENERIC COMMUNITY DEVELOPMENT MODEL

A generic system dynamics model contains structures and behaviors common to a general class of phenomena or to a system. The identification of such general relationships may be based on theory or experiential evidence. The general type and form of information readily available to communities are also important factors in developing a generic community model. Based on the sociological/community development literature it was difficult to choose among the various theoretical constructs regarding communities. Therefore an inductive approach to model specification was taken. Accordingly, a survey of system dynamics models that appeared to be similar in purpose and/or content was made. At the same time, community studies undertaken by the University Extension were surveyed to identify the recurring types of problems and the data bases made available to the communities on an ongoing basis.

Eight system dynamics models which were documented in some detail were studied. More specifically, the following questions were asked:

1. Which issues, clients and problems do the models intend to address?
2. How is the model limited in its scope (system boundary)?
3. What major subsystems are included and in what detail?
4. How are the variables aggregated?
5. What constitutes the major causal hypotheses?

The answers to the first four of these questions were summarized by preparing a table. The answer to the last question required a finer analysis. Therefore, a commonly modeled variable, migration, was singled out and studied within the context of three models which included this variable. This review revealed that the structures given to the community systems and subsystems are very different from one another. This is true even when the researchers' stated purposes are similar. In other words, this survey did not indicate a common set of variables or relationships which could form the basis of a generic model. However, two models given by Hamilton (1969) and Sancar (1977) appeared to be the most general purpose ones.

Next, the types of community development problems and the data bases available to communities in Wisconsin were also investigated. It was found that the University Extension in cooperation with various departments followed an established approach which has been applied to a large number of communities and small towns. This approach consists of six separate studies: a visual analysis, a community consensus survey, a trade area survey, a survey of local business people, a threshold level analysis, and a business district design. Any or all of the studies may be undertaken at the request of the communities. In addition to the above studies two other data sources were identified consisting of a database for community economic analysis (Hustedde et al. 1984) and a detailed survey of industrialists' concerns and intentions to expand or relocate, conducted by the Bell Telephone Company. These studies provided the general concerns, the established common language regarding the variables and concepts, and the secondary sources of data which may be used in customizing a generic model.

Based on the above information a tentative community model was constructed by combining the main features of the Hamilton (1969) and Sancar (1977) models so as to reflect various documented concerns and take advantage of the available data sources. At this stage the generic model consists of a global causal-loop diagram showing the main subsystems and their interaction, and a list of state variables (Figures 2 and 3). It was assumed that the situational system dynamics model would reflect the global causal-loop diagram and all of the subsystems; however, it may contain more or less number of sectors and any number of additional parameters.

PROBLEM STRUCTURING

Structural models portray the features of the situation and employ graphic techniques to show how these are interrelated. Therefore they may be used to build the necessary conceptual bridge between the mental/prose models and the dynamic models and to enhance and document the thought process. The general criterion for such techniques is that they should reflect human perceptions and help to integrate them into systems modeling by providing the necessary cognitive aids for individuals and groups to cope with complexity. In this section, the general characteristics of structural modeling, more specifically of Interpretive Structural Modeling, will be explained. Then, an enhanced, more detailed version will be proposed which further specifies how each decision within the structuring process will be carried out in order to encourage creativity and improve human inferences and judgements.

The Interpretive Structural Modeling (ISM) technique which is an advanced representative of the general class of structural models, has been developed to compensate for bounded rationality (Simon 1969), which imposes severe limitations to mental activity in dealing with complex situations.. This limitation results in premature structuring and avoidance of complexity leading to an arbitrary or biased selection of entities or variables, objects, events, and relationships to be considered in problem solving. ISM is a content-free technique. Its main advantage lies in the fact that once an entity list and a relational proposition is specified, the situational structure can be generated without being adversely influenced by the above mentioned mental limitations. This is achieved by evaluating the entities two at a time via an interaction matrix. There are three major steps in the implementation of ISM (Wilson 1982). These are: 1. the determination of the variables and the relational proposition; 2. the generation of the interaction matrix; and 3. the derivation of the structural network.

In the first step, the variables are listed and the corresponding relational proposition is determined. These variables may be activities, elements, attributes, issues, problems, objectives, or opportunities. The relational

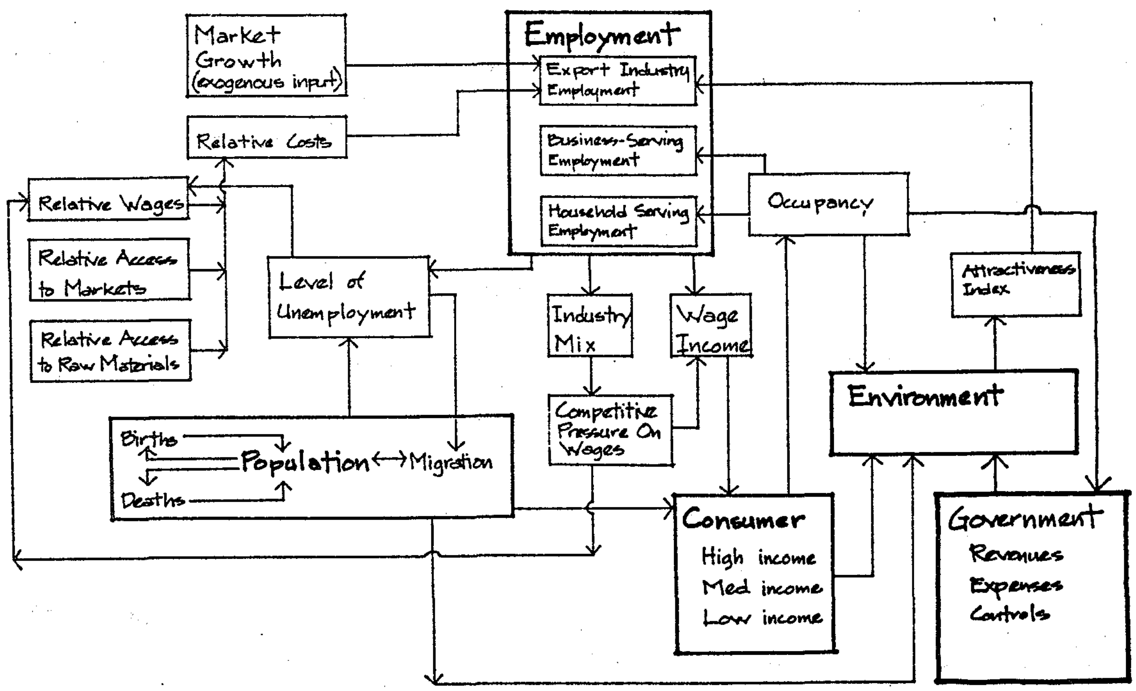

Figure 2. Generic Community Development Model

proposition, is in turn, a statement framed as "facilitates the solution of," "influences," "is subordinate to," or the like. Each of these expressions represents a different way of "framing" the situation, or an alternative perspective. Once a perspective is chosen, all variables have to be consistent with it. In general, this consistency check is completed by the facilitator. The relational variable is determined based on the nature of variables. The generation of the interaction matrix is conceptually straightforward. It may be done by paper-and-pencil, or interactively on a computer; by the individuals or as a group. Finally, the matrix entries may be evaluated as to importance by ranking and rating. The derivation of the structural graph is accomplished by the use of an appropriate software designed to generate "di-graphs" from the given set of matrix interactions.

In this study the main function of the ISM prior to simulation modeling is to reflect a collective appreciation of the situational context. It is this representation which subsequently becomes the decision environment, and is expected to influence future decisions. There are alternative ways of

POPULATION
- Children (0-13)
- Teenagers (14-19)
- Young Adults (20-24)
- Prime Age (25-44)
- Middle Age (45-64)
- Old Age (65+)
- Births
- Deaths
- Migration

CONSUMER
- High Income
- Middle Income
- Low Income

ENVIRONMENTAL
- Open Space
- Vacant Land
- Building Quality
- Parking
- Attractiveness to Industry

EMPLOYMENT
- Export Industry Employment
- Business-Serving Employment
- Household-Serving Employment
- Skill Level
- Wage Income
- Unemployment
- Industry Mix
- Competitive Pressure on Wages

Other Economic Variables
- Market Growth
- Relative Costs
- Relative Wages
- Relative Access to Markets
- Relative Access to Materials

OCCUPANCY
- Industrial Establishments
- Business Services
- Convenience Stores
- Shopping Stores
- Specialty Stores
- Entertainment Establishments
- Housing
- Vacancy

Figure 3. List of Generic Model Variables.

carrying out the three steps conceivably having different impacts on the final outcome in terms of achieving the following additional objectives:

1. Generating creative options, or "systems design",
2. Learning through search and interpretation of information concerning facts and values relevant to the situation and overcoming judgemental and inferential biases,
3. Generating and documenting information concerning the interactions among participants; their negotiations concerning different interpretations of reality, and the different perspectives and how they are changed and modified.

To incorporate the above considerations into the ISM, four explicit decision points were introduced. This modified version of the ISM is given in Figure 4, where the decision points are represented by the diamonds in the flowchart.

Procedural guidelines to improve these decisions are derived from applicable literature in various fields dealing with human judgement and decision making and social-psychology of creativity. The application of these guidelines also depend on which of the prototypical planning problems" (Kristensen 1985), best represents the situation. The activities at each decision point have been called 1) framing, 2) categorization, 3) interaction specification, 4) derivation and testing of the network. These activities will now be described in detail since they constitute the major novel elements of the proposed decision support system using ISM.

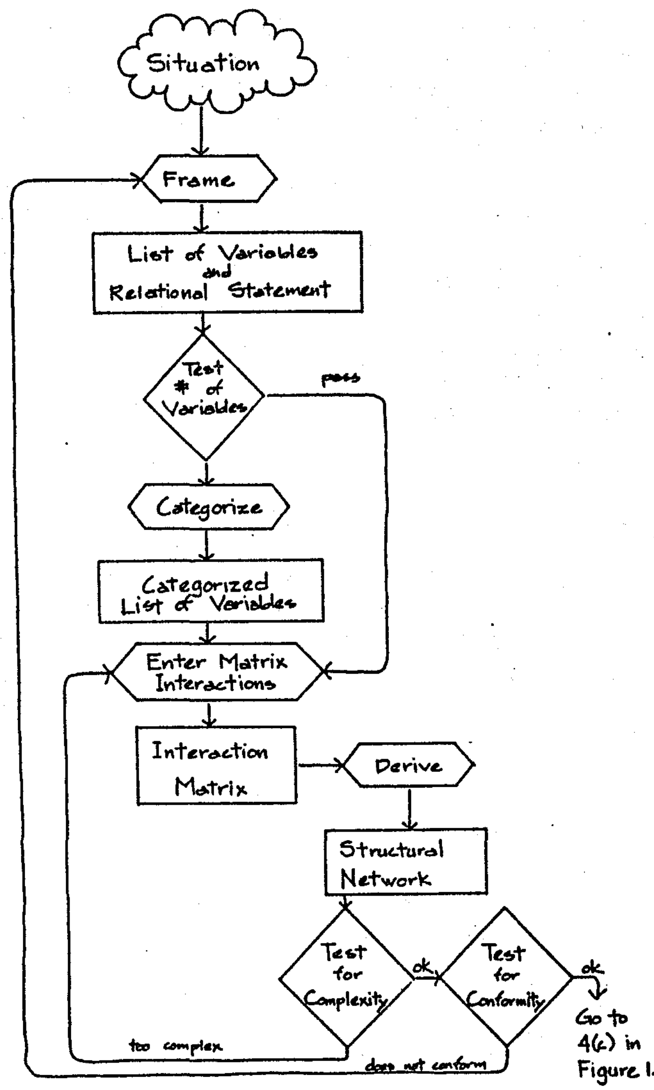

Figure 4. Flowchart for Problem Structuring

FRAMING

The outcome of the first decision point is a list of variables and a relational proposition. During framing each question or probe used to generate the list of variables which are thought to be relevant/important by the participants represents a different way of "framing" the situation, or a different perspective. The choice of a perspective (for example, listing variables as problems rather than opportunities) and the name given to the situation in terms of scale and specificity, may enhance or limit the group's problem solving capabilities.

Working within a "scenario/schema" or perspective increases fluency in generating ideas and in noticing relevant elements, while limiting the possibility of discovering original ideas which will contribute the most to the process. Once a perspective is established, it influences causal inferences as well as predictions. These judgements, then, may prove to be very resistant to modification even in view of new information (Nisbet and Ross 1981). Each member of the problem solving group is likely to have a dominant perspective of the situation determined by cognitive style (Mittroff and Turoff 1973), motivational factors, and their past involvement with the issue at hand (i.e. situational factors). These should not be externalized or imposed on the group at this point. Therefore, the situation should be referred to in less specific terms than any individual member would avoiding value-laden statements. For example, statements such as "We have been assigned to this citizens task force to discuss and recommend solutions regarding the various problems our community is facing; such as increasing property taxes, crime and vandalism in various neighborhoods, and closing down of the Happy Brewery" should be avoided, because 1) the situation has been framed as a "problem" situation, and 2) a certain set of problems have been prematurely emphasized.

Whatever the scale or specificity of the perceived situation may be, there are two opposing ways of framing. One is the problem analysis perspective and the other is the system design perspective (Sancar 1983). In most cases, especially when the situation is "messy", the former perspective is likely to be dominant. Since the advantages of adopting the latter perspective are numerous (Nadler 1970, Ackoff 1978, Checkland 1981, Sancar 1983), if the statements turn out to be problems, the opposing perspective may be introduced by "re-framing" (Bandler and Grinder 1982).

The size of the variable list should not be limited at this stage, since such an effort imposes arbitrary screening of ideas and limits free thinking. To achieve this objective and to ensure that ideas are generated by all the group members alternatively (rather than each person presenting a more or less self-contained perspective), a combination of triggering and round robin brainstorming session (Rickards 1982), brainwriting or "method 635" (Warfield 1975) may be used in this step. From the initial listing, participants may also be asked to identify which of the elements are controllable and which are not. This type of inquiry may foster additional branched thinking and may serve to broaden the base of elements from which the entire analysis begins.

During editing, the mediator takes the preliminary list of elements and edits them for eventual inclusion into an intersection matrix. This is done by checking redundancy of statement substance, uniqueness and ambiguity of each statement. The resulting list is then presented to the group for approval.

Selecting the relational statement is an important step following the editing phase. This statement provides the conceptual building block for the selection of matrix interactions and the relationships which will eventually appear in the situational model. This statement should be consistent with the appropriate options listed in Figure 5 below. For instance, if they are comparing opportunities or alternatives, they will be asked to consider whether they are operating within a positive (desired state) mode or in a negative (removing the constraints) mode. They are then presented with the accompanying verbal operator to test whether it fits their perceptions of a proper comparison.

Format	Option	Operator
1. problem	positive/negative	influences
2. opportunity/alternative	positive/negative	helps/hinders
3. phenomenon/issue	neutral	influences
4. attributes/functions	neutral	is related to

Figure 5. Options For a Relational Proposition

CATEGORIZATION

This decision point consists of two tasks which are categorization of statements and creation of an initial causal loop diagram using the category names. If the list generated in the previous stage is large (more than 7-10 statements), completion of the relational matrix becomes consistently harder. In this case, categorization is advisable. Categorization will introduce the simplest way of structuring or achieving some coherence in a situation. This process will force the group to create a common understanding of terms and definitions. The participants will begin to see initial interactions as those within the categories and those between them prior to actually working on the matrix. The resulting element categories will become an anchor for the group during the discussion of matrix interactions. In this way, keeping the responses consistent during the next step will be facilitated.

There are two alternative strategies to categorize the elements, in one case the generic model is introduced to the group, whereas in the alternative strategy it is not and the categorization is achieved discursively by making similarity judgements. In the first case the group is asked to assign each element to one of the sectors, or to a "new sector". In the second case, a randomly chosen statement is used to start the process, and it is compared to the next statement in terms of similarity (of difference). If it is found different, then a second category is established. The third statement is then compared with one and two; and either assigned to an existing category, or is used to create a new one. Prior to the assignments, discussion takes place which may result in modifications of the original statements. The process continues until all the statements are assigned to a category and the number of categories is not larger than approximately ten.

The choice of one of these strategies over the other depends on the type of problem the group appears to be dealing with in terms of uncertainty due to goal conflicts and/or availability of alternative solutions (Kristensen 1985). In those communities where prior research on needs (Community Concensus Study) have been done, both of these conditions can be readily identified. Otherwise, the same measures can be applied to the initial unedited list of statements. Goal conflicts are measured by the agreement between public officials, community leaders, and residents regarding the importance of problems. Availability of alternative solutions is reflected by the number of problem statements which in effect contain solutions.

When uncertainty level is high, both goal conflicts and lack of alternative solutions are observed. Also, instead of emphasizing one or two types of problems (such as traffic or sewage treatment), a number of problems receive relatively high ratings. When this is the case, it is expected that the group will not be ready to accept the generic model categories, and the second strategy will be more appropriate. On the other hand if the group appears to have a more clear idea about available alternatives, and when they perceive the challenge to be exploring the various interactions between these, then it is more likely that the generic model will prove to be a valuable guide. Once the categorization is finished, before taking the next step, studying a global causal diagram showing relations between categories establishes the general framework to be used to enter the larger matrix interactions.

INTERACTION SPECIFICATION

This decision point involves two tasks; the specification of the existence and the nature of interactions among elements and the evaluation of the specified relations by ranking and whenever possible, rating. The first task may be performed interactively on the computer or manually; individually or in groups. If the task is completed individually, aggregation of responses need to be considered. If the relational proposition assumes transitivity, then most computer programs automatically reduce the number of interactions that need to be completed, thereby increasing the efficiency and the reliability of the procedure.

Completing the above tasks requires that the participants make causal inferences. From a cognitive standpoint, the framing of the situation, the information or data available to them, and the procedures that are used to interpret the data are important factors which influence their judgements. People use various judgemental heuristics in making inferences, and are successful in many cases. The observed shortcomings and biases in human judgements are due to either inappropriate use of these heuristics or due to failing to make adjustments on initial judgements in view of new information.

Causal inferences are of two kinds which are contingency framing and outcome framing or prediction. Contingency framing may lead to erroneous inferences due to inappropriate use of the "representativeness heuristic, and the "availability" heuristic. Representative heuristic is the tendency to attribute overt behaviors or problems to systemic dispositions or anomalies rather than environmental influences by ignoring situational factors. An example would be to attribute a drug and vandalism problem to a general lack of law and order instead of attributing it to the closing down of the local YMCA and the discontinuation of various youth programs due to a lack of funds. The availability heuristic refers to the effect of the degree of availability of causal factors; their salience and ease of retrieval, on causal inferences. An example would be the influence of a recent news item about police negligence in a youth committed robbery in making the same kind of attribution as above. This points out the effects of both perceptual and verbal manipulations on inferences.

Biases in making predictions are mainly due to failures to use "base rate" data such as prior probabilities, population proportions, and central tendencies. All too often people make judgements on the basis of single events which seem to support their pet theories, or which are vivid, even when they are presented with contradictory objective data. For example a businessman may refuse to participate in a beautification program, because he knows of a business in another town which went bankrupt a year after spending all that money on a face-lift. All the base rate information which shows the positive effect of beautification on sales, will not change his mind.

Both of these biases may be traced back to the "theories" people bring to situations, and also to the types and forms of data/information available. The impact of data on changing or modifying prior theories is very little unless certain conditions are met. The most important condition is to supplement base rate information with causal explanations, i.e. with an alternative theory. The generic model, and a study of the global causal relations between the sectors after categorization is expected to facilitate the introduction of causal explanations for the data. The second condition has to do with presentation of data. People weigh data in terms of its vividness which is based on emotional interest, concreteness, and spatial or temporal proximity. The research in this area suggest that unless the situational base rate data is presented vividly, they will be ignored.

From the above discussion it becomes apparent that the awareness of various biases, and efforts to minimize them via framing and data presentation, will lead to more enlightened inferences. Nevertheless it is also acknowledged that there is no one correct way of interpreting the situation in a social context since judgements are also guided by concerns other than "correctness," such as fairness and justice. In a group context, in addition to introducing the above statistical realities (e.g. the base rates), which clearly favors quantitative information, a more flexible approach which accepts the presence of competing explanations and embraces qualitative information will be more appropriate. An example of such a procedure is "assumptional analysis" (Mason and Mitroff 1981) developed to organize various parts of an argument, such as "warrant", "backing", "claim", "rebuttal"; in interpreting information. The importance ratings can then be used to simplify the matrix so as to have three to five interactions per column (or row) and avoid complicated networks lacking conceptual clarity and visual impact.

DERIVATION AND TESTING OF THE NETWORK

In the fourth decision point, the matrix is evaluated by using an ISM computer program. The program output is a "directed graph" that shows a hierarchy of variable clusters and relationships among them. This output is translated into a graphic network representation using a heuristic algorithm which will not be given here for lack of space. An overly complex network (too many lines crossing) reflects either the presence of too many matrix interactions or unclear thinking. In the first case the situation may be remedied by resimplifying the matrix interactions, while in the second case the logic of interactions must be reconsidered.

After the network graphics is finalized, its general features are discussed to see whether this is an acceptable representation of the situation. At this point it may be possible to reduce the problem into separate routine tasks to be assigned to appropriate existing public or private organizations. Otherwise, the group is ready to start building one or more situational simulation models to generate and test alternative solutions.

PROCEDURAL TESTING OF PROBLEM STRUCTURING

The problem structuring procedure described in the preceeding sections were tested using two cases of community development previously studied and extensively documented by the University of Wisconsin Extension for the towns of Jefferson (Such, 1983) and Racine (Drewiske, 1984) in Wisconsin.

The Jefferson case was an example of a problem with high uncertainty. There were a high number of problem statements with few solution implications suggested by the community members at a downtwon retreat. The relational statement used was "The solution of problem A will help/hinder the solution of problem B." Categorization was done by clustering the elements in terms of their differences.

The Racine case, on the other hand, represented a more structured situation. All the issues were stated as opportunities related to a harbour and marina development along with other recreational, residential, and commercial development potential. Hence it was easier to use this generic model as a guide to categorize the variables and to specify the interactions. In this case, the relational proposition was "Achievement of A will support/hinder the achievement of B."

The resulting networks for the problem are shown in Figures 6 and 7 for Jefferson and Racine, respectively. Based on these two examples and their networks, several observations can be made. The Racine network in Figure 7 is conceptually more clear even though the number of variables are almost twice as many as those for the Jefferson case. This is due to the use of the generic model structure in defining the matrix interactions. However, in both networks it is possible to clearly identify meaningful clusters of variables and their relation to the generic model sectors. Furthermore, by examining the input/output arrow configurations, the major dependent variables; the throughput variables; and those variables which appear as either uncontrollable, trivial or external policy/decision variables can be determined. At this time, the major feedback loops involving the main dependent and throughput variables and the paths at their interfaces also become apparent.

Since the two cases described above have not involved the active participation of stakeholders or the base rate information, no conclusions could be drawn regarding the strategies for information presentation and group dynamics. However these aspects are being investigated in a follow-up application and will be reported subsequently.

DEVELOPING THE SITUATIONAL SYSTEM DYNAMICS MODEL

The situational model is generated by transposing the elements of the completed structural model into a system dynamics model. We note here that customization actually begins with the framing of the situation. The integration of the situational and the generic models can then be initiated at
Figure 6. Network Representation of Jefferson Case
one of th following steps corresponding to the various decision points:

1. In the "editing phase," where convergence between the terms in the generic model and the participants' statements may be achieved,

2. In categorization, where the generic model categoires may be used to recognize the participants' statements into clusters,
3. While generating matrix interactions, when the various interactions can be guided by the causal linkages of the generic model.
4. After the completion of the structural model, at which point items (1) through (3) above may or may not have been applied.

After the completion of the structural model further customization can be continued via the following activities:

1. Comparing the sectors of the generic model with the variable cateegories in the interaction matrix,
2. Comparing the variables in the network by the state and flow variables in the generic model,
3. Deciding on the level of aggregation of each sector based on the above comparisons,
4. Comparing the main feedback loops in the structural model with those in the generic model,
5. Deciding on the relationships to be included in the situational model with their incorporation into the generic model.

With the completion of these activities the situational model can now be used to generate and test various policy options. Since the community members' participation in the construction of the model has been maximized, it is expected that they will now be able to take part in the model testing and experimentation phases. These steps have not been carried out for the two cases reported above. Complete application of the procedure, including the development of the situational model will be implemented for another case in the next phase of this study.

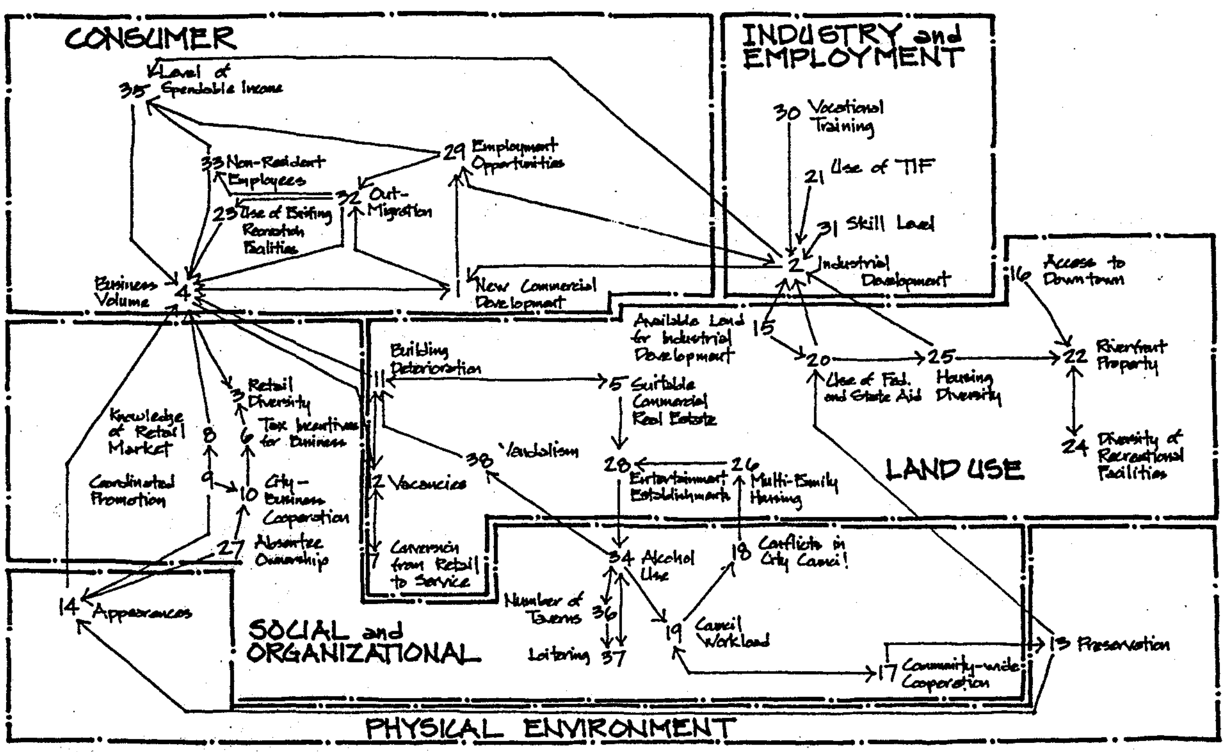

Figure 6. Network Representation of Jefferson Case

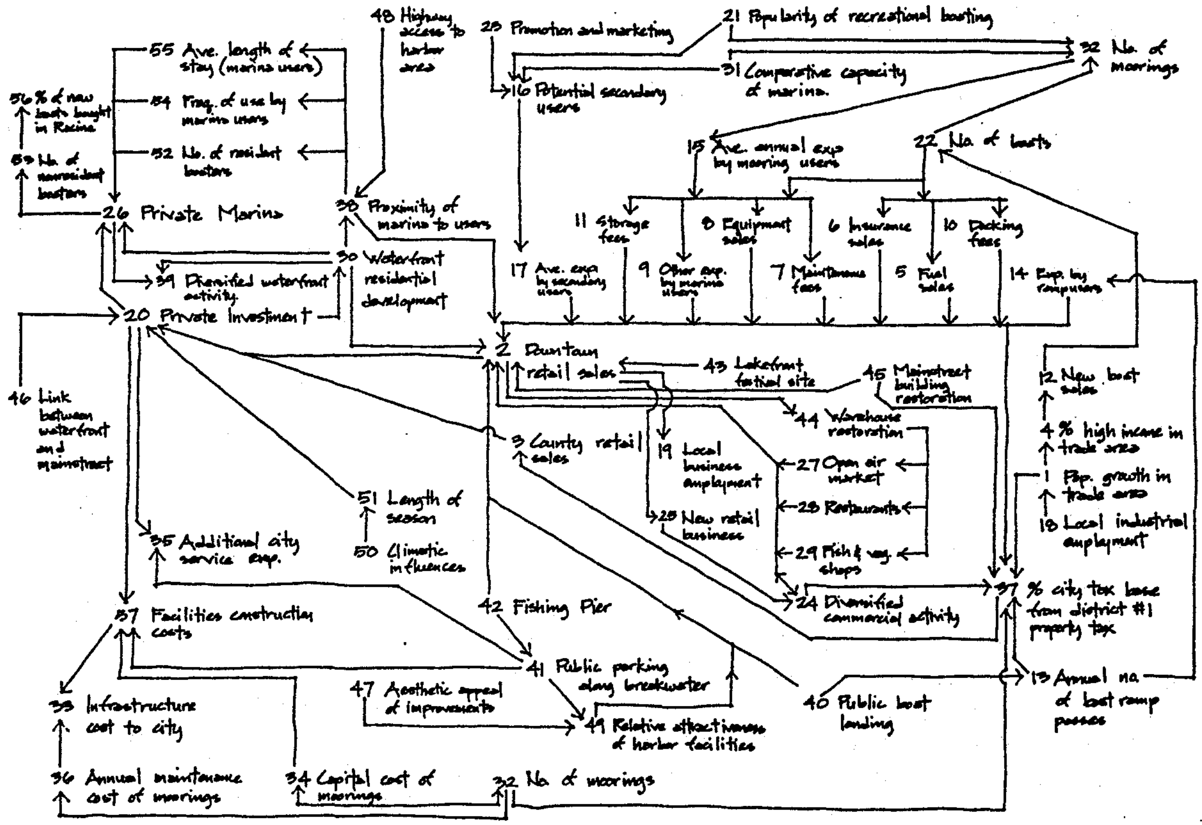

Figure 7. Network Representation of Racine Case

CONCLUSIONS

Recent discussion among System Dynamics researchers and practitioners refers to generic models as tools for the analysis of problems common to classes of systems. Such developmental work will contribute to the achievement of a common understanding of significant problems on the part of model builders and users, and an efficient approach to the study of systems differing only in unique, context specific ways.

In this paper, a procedure for the development and customization of a generic model for rural community development has been described. The components of the procedure have been presented as decision aids within the context of a larger methodological framework developed for resolving unstructured problems. These consist of a generic communty development model, a problem structuring algorithm, and a situational system dynamics model.

A survey of various system dynamics models of community, regional, and urban systems indicated that there were no common variables and interactions which could form the basis of a generic community development model. A tentative generic model structure and a list of variables were chosen from two of these models which appeared to be the most general purpose ones, keeping in mind the data sources commonly available to small towns and rural communities.

The problem structuring algorithm was developed by introducing explicit decision points - framing, categorization, interaction specification, derivation and testing - into the Interpretive Structural Modeling process. To impelment each of these decisions, guidelines based on cognitive criteria to enhance the participants' information processing capabilities while reducing inferential biases were provided. The procedural mechanics of the problem structuring was tested using previously compiled community development reports of two towns in Wisconsin. The resulting networks showed meaningful clusters of variabls and it was possible to relate them to the generic model sectors. Finallyk the steps required to develop the situational system dynamics model by integrating the structural networks and the generic model were described.

In the following phase of the study, the entire procedure will be applied to a community development case involving the community members. The benefits expected from the implementation of th procedure can be summarized as follows:

1. Cognitive facilitation: the participants will be able to use more and better informaton regarding their community; their understanding of the systemic interrelationships will be enhanced and more consistent with the objectives data and available theories.
2. Social facilitation: the number and diversity of prticipants will increase as the problem structuring activity proceeds. The participants will acquire a common language as reflected in the use of similar terminology and consistent definitions, i.e. will have developed a shared perspective of the situation. Reaching a consensus will be easier, or sources of disagreement will be clear.
3. Creativity: the number and originality of solution proposals will increase, and th participants will enjoy taking part in the activity and express satisfaction with their contributions.

Even though it will not be possible to put the proposed procedure through a rigorous testing with respect to these expectations, appropriate measures will be taken to provide insights concerning the successes and failures.

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