

COMPUTER SIMULATION OF ORGANIZATIONAL CHOICE PROCESSES UNDER CONDITIONS OF
AMBIGUITY AND CONFLICT - THE CASE OF WEST GERMAN UNIVERSITIES

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ABSTRACT

This article deals with the computer simulation of processes of organizational choice under conditions of ambiguity and/or conflict. It is in line with efforts by Cohen, March, Olsen and others to investigate in those areas of problem resolution and organizational choice, which have not been covered by traditional rational theories relevant for organizational choice and problem solving such as organization theory, microeconomics, operation research, or planning theory. It goes beyond these efforts by taking into account a realistic organizational structure, non-choice processes, communication and activation processes, basic political conflict, and long-run changes in choice processes by certain outcomes of personnel decisions.

A corresponding computer simulation model implemented in SIMSCRIPT II.5 and some experimentation and validation endeavors are described. The model serves at this stage of development above all as a conceptual framework for theory and empirical research.

Most of the incorporated special assumptions stem from observations of choice processes and interviews of participants in West German universities. It is argued, however, that conditions of ambiguity and conflict hold for many organizations.

1. INTRODUCTION

In recent years some authors have investigated organizational choice processes under conditions of ambiguity(2, 3, 4). Ambiguity is related in those studies to

1. organizational goals and appropriate measures of performance,
2. organizational technology in the broadest sense to be employed to attain these goals,
3. participation, where the right to participate not necessarily also generates the actual participation,
4. interpretations of experiences and learning.

Although instances of these conditions are well known with many people involved in organizational decision processes, the traditional scientific framework for conceptualizing processes of organizational choice as provided by organization theory, microeconomics, operations research, or planning theory seems to be inappropriate. In general this framework relies too heavily on conditions, where goals, technologies, participation, and experiences are considered as clear and unambiguous, where there is a "complete" cycle from individual cognition to individual action to organizational action to environmental reactions that are fed back into individual cognitions again.

Cohen et al. (3) have proposed an alternative view. They consider an organization to be " a collection of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues, to which they might be the answer, and decision makers looking for work. " (3: p. 2).

In an attempt to make the processes understandable and to explore the consequences of this view they developed the imagery of a garbage can - a choice opportunity " into which various kinds of problems and solutions are dumped by participants as they are generated. The mix of garbage in a single can depends on the mix of cans available, on the labels attached to the alternative cans, on what garbage is currently being produced, and on the speed with which garbage is collected and removed from the scene " (3: p.2).

Out of this imagery they developed a simulation model which assumes four components: 1. problems or issues, 2. solutions (implemented as time required to solve a corresponding problem), 3. members of the organization, 4. choice opportunities. They consider these components to be independent.

With regard to the way and extent problem solutions are generated they investigate especially the effects of different timing of problems and choices, different capacities members have in order to solve

the problems, and different structures determining the type of access problems and members have to choices.

This paper describes an effort to elaborate this model with regard to three effects:

1. Since the model was developed on a very general level it is very hard to link practical experiences and the perception of participants to their representation within the model and its outcomes. To develop further this view of organizational choice processes it is necessary to model them in greater detail. This is especially true for the social structure, and the behavioural assumptions, and the concept of ambiguity.
2. Some important but neglected aspects of choice processes have to be included, e.g. communication, activation of members for participation, and decision rules that allow for coalitions.
3. Some assumptions seem to be unrealistic in view of experiences and research in university decision processes (an arena where the garbage can model is expected to fit especially well). They have to be modified.

The goal is not only to verbalize these points but also to incorporate them into a simulation model. This has two advantages. It frees the modeler in this early stage of development from too many assumptions other formal representations call for and therefore does not heavily narrow down the growing concept. And on the other hand it furthers the virtue of being unambiguous in writing down one's assumptions and makes it possible to explore also very complex dynamic interrelationships.

The area of experience is drawn from West German universities. Although there is a great deal of similarity concerning the ambiguity in goals and technologies between United States universities and West

German universities it seems to be necessary to mark some differences relevant for the topic of this paper.

1. According to the role structure West German university members can be roughly classified in students, scientific assistants (somewhat similar to an assistant professor, however, often without a doctoral's degree and more dependent on professors) professors with tenure and service personnel.
2. West German universities are state universities with an administration of their own but with a growing tendency that the state will take over important competences as e.g. personnel decisions to avoid disagreeable decisions by the university.
3. The decision committees on each formal level (university, department, institute) are formed by professors, scientific assistants, students and service personnel. The members of the committees play the leading part in the self-administration of West German universities. They are, however, strongly stressed by demands generated by the true working processes as learning, teaching, research, service as well as by the decision processes they are necessarily involved in.
4. The seats are distributed among the role groups in such a way that the professors have mostly half of the seats, the scientific assistants have more than the students and the students have more seats than the service personnel. Every role group elects its representatives. Within and across the role group different (from "left" to "right") political groups are competing for becoming elected. The political groups form an informal but strong structure within the universities.

2. ELABORATION OF THE CONCEPT

1. The garbage can model presupposes the independence of problems, choices, members and solutions. The concept of a problem, however, calls for a close relationship between members and problems. A problem can be described by
 1. a model A which represents the perception of a situation the perceptor respectively the problem owner is dissatisfied with
 2. a second model B model A is to be transformed to - the situation the perceptor conceives to be satisfying
 3. a transformation T from A to B - the set of all perceived technologies or solutions.

The problem cannot be separated from its perceptor. This holds even if one assumes that most problems are not generated by the individual but by society. Experiences show that many problems are carried with certain problem owners in and out of a choice situation. They disappear if the problem does not take part in the discussion any longer. It is to be assumed therefore that certain problems belong to certain members depending on their location in the political and role structure (see below).

2. The concept of ambiguity has two aspects:
it may mean an agreed upon lack of evidence and it may mean conflict where different interest groups have different goals, and different technologies and where each group thinks that it knows what it wants and what it does. The conflict aspect has been neglected by the garbage can model.
Conflict is only seen as a consequence of the choice processes and is measured by the activity of problems.

On a very high level of abstraction you may subsume conflict under the agreed upon lack of evidence. If you, however, try to consider also individual activation and problem resolution and its relation to society you have to take account of e.g. political attitude and role group of the individuals which Noel/Fontana (5) describe as strongly determining behaviour of university members. This means that, viewed from a lower level, the individual's behaviour is not quite as much intention-free and uncontrolled as generally assumed by the garbage can model, although there is a lot of arbitrariness left. In the following we will refer to the agreed upon lack of evidence as ambiguity and to the conflict aspect of ambiguity as conflict.

3. If there is conflict and ambiguity over A, B and T general behavioural consequences can be expected (see also 6).
 1. Because of conflict and ambiguity many problem definitions and many resolution approaches are possible. There are no agreed upon criteria for ending the problem resolution process. These processes are very often finished when terms have expired or money is exhausted or other more important problems come up. The momentarily achieved degree of problem resolution will then be declared as satisfying.
 2. If there exist resolution proposals, there are no agreed upon criteria to judge from. So they cannot be declared as wrong or right but only as better or worse if they can be compared at all.
As a consequence the proposals are often evaluated according to the work or energy or time invested in the resolution process and not with regard to the outcome.
 3. The participation in problem resolution processes is no longer generally rewarded. The participation is judged from the world view the

participant tries to bring in. Dependent members of the university, especially students, service personnel and scientific assistants may hesitate to take part.

4. The university members, who are only a limited time members of the university, are not very interested in problem resolution processes which are expected to take a long time or in long term consequences of an implementation of a solution. They are more interested in processes which are expected to take a short time. This tendency is intensified even more the less time is left before exit.
4. The participants of a choice process generally do not concentrate on a certain choice process alone. They are also participants of other choice processes, and of other university activities like teaching, learning, research, or service and of extra-university activities like family life, sailing, theatre and so on. If they are participating in one activity they will not be able to participate in another to the same time. Since the participants determine with their problems and solutions the interpretation of the choices and therefore also the decision, the other activities and their energy requirements responsible for the member's absence or presence, have to be included in the model. So the complexity of the organization and its environment is added to the the complexity of a single choice process. The direct coupling between a certain problem content and a corresponding choice process, already loosened by points 2 and 3 above, is relaxed even more.
5. The garbage can model has incorporated only a collegial type of decision rule: choices are made when all problems attached to that choice are solved. Coalitions, so that only a majority

has its problems resolved, or situations when choices have time limits and a decision has to be made even if no problem is fully resolved are not included. This may have to do with the limited notion of ambiguity. Coalitions are a natural consequence of including conflict. Time limits are an important instrument for changing the order of choice processes.

6. The garbage can model has also not taken into account formal and informal communication processes. A member can only take part in a choice process if he is informed of the choice. While it is easy to describe the formal communication processes, it is difficult to describe the informal communication processes. From interviews in the departments of a West German university it could be concluded that the communication patterns can nearly exclusively be explained in terms of political attitude, role group membership, and work relations.
7. If someone is informed of a choice he needs to be activated to take part in the choice process. The activation process has not been included in the garbage can model processes. The activation depends heavily on the relevance the choice has for the individual's problems, on the other processes, the individual is involved in, and their relevance, his time budget, and the solution chances for the attached problems.

3. THE SIMULATION MODEL

DESCRIPTION

The model consists of sets of

1. structural assumptions
2. behavioural assumptions
3. persons (members of the university or of the environment)
4. problems (with their situations implemented as solution times)
5. choices
6. and a set of processes operating on the members of the other sets

1. The set of structural assumptions consists of

- 1.1. a role structure which divides the members of the university in professors, scientific assistants, students and service personnel: specifies the maximum time of membership for students and scientific assistants and the comparable planning-horizon for professors and service personnel; determines the role expectation structure defining the expectations concerning the time every role incumbent is expected by relevant societal groups to spend on his activities (research, teaching, choice processes, extra-university activities for professors and scientific assistants; research, learning, choice processes, extra-university activities for students; further education, service, choice processes, extra-university activities for service personnel); determines the extent of punishment if they do not live up to the expectations by specifying the willingness to spend more time than expected to the societally not rewarded participation in the choice processes.

- 1.2. a formal structure which divides the university into a number of formal units, e.g. research

group, institute, departments, university, environment.

- 1.3. a decision structure which determines the institutional decision bodies with regard to their establishment, composition, and decision rules at the various formal structure levels.

- 1.4. a coupling structure which indicates the looseness of the coupling between the different levels of the formal structure and the corresponding higher levels as the higher level's right to revise the lower level's decision.

- 1.5. a problem structure which indicates how much energy is approximately necessary to provide a resolution for a certain problem.
This amount has to be modified according to certain organizational situations and experiences of persons or groups working on the resolution.
It also categorizes the problems in terms of their world views.

- 1.6. a person-problem structure which indicates the problems each person has momentarily as well as the problems a member has already resolved.

- 1.7. a choice-problem structure (cp.3) which indicates what choices are principally relevant for what problems.

2. The set of behavioural assumptions consists of

- 2.1. a political structure which provides

for political groups all persons (members and non-members of the university) may join corresponding to their political attitudes. The political groups range from "left" to "right". They have certain problems. Their members work together on common problems and try to make decisions which solve their problems to hire people with a similar political attitude. The political groups can develop at each formal structure level and may have there different compositions with regard to the political attitudes of their members.

2.2. a communication structure which determines the probability of communication of persons with each other dependent on their location within the dimensions of the set of structural assumptions, their location in the political structure, their location in the activation structure (see below), and individual constraints, especially their energy structure (see below), and the importance of the choice to be communicated about.

2.3. activation structure which determines how much attention persons give to certain choices and the extent they are activated depending on their location within the dimensions of the set of structural assumptions, their location in the political structure, individual constraints, especially their energy structure, and the other choices and problems they are attached to.

2.4. an energy structure which determines for each person the energy (time) spent for different activities during a certain number of past time periods, compares it with the values of the role expectation structure, and calculates from this the amount of available energy(time) at each point of time for each type of activity for a certain amount of future time periods. It determines also the flexibility of each activity, that is that pro-

portion of the activity's expected time that could immediately be spent for urgent choice processes.

3. Persons are described in terms of their membership in the role structure, the formal structure, the decision structure, and the political structure, in terms of their momentary and past problems and in terms of their energy structure.
4. Problems are described by the problem structure and their relation to the role structure and the political structure.
5. Choices are described by their relation to the formal structure, the role structure, the political structure, and the decision structure, their relation to problems and to persons and their time limits.
6. The processes consist of

- 6.1. "bookkeeping" processes which establish according to certain election rules the composition of the decision bodies, determine the membership in political groups, the location on the political attitude scale, calculate the attention, communication, and energy structure, realize the decision outcomes, and provide for the entrance and exit of university members.
- 6.2. organizational choice processes; they consist of information processes, activation processes and decision processes in a narrow sense

- 2.1. Information processes provide for the communication of choices according to the communication structure. The information process on a certain choice is stopped when the last responsible decision committee has finally decided upon it.

- 2.2. activation processes are involved after a person has been informed on a certain choice. During the process the person evaluates the choice in terms of the related problems, its relations to his location in the formal, role, and political structure and with regard to his energy structure. A corresponding importance

factor is calculated. This factor determines how often an informal communication is started by the person. It also helps to distribute the time available for choice processes among all choices of the individual. Unless the individual has no problems related to the choice, he will be activated for the choice. The deactivation takes place after the problem resolution process has been started, because it is assumed that the individual only gradually discovers that he is overloaded with work on choices and the corresponding problems, i.e. when he is already in the process of problem resolution. Not before then he retreats from some choices.

2.3. problem resolution processes describe how time is distributed among the choices and the corresponding problems of the individual and the progress of problem resolution. The time available for choice processes is at first distributed among the individual's choices according to the importance factor and the time limits of the choices. For this purpose two sets are formed. The first set consists of choices c_i ($i \in I, i=1, \dots, m$) with the time limit expired by the time of the next meeting of the responsible decision committee or at some other point of time. The second set contains the remaining choices (with $j \in J, j=1, \dots, n$). Both sets are ordered by declining importance according to the importance factor. All choices c_k are now ordered according to

f: $I, J \times K$
 with $K = \{k; k=1, \dots, m+n\}$
 and $\forall i(i \in I) : k=i$
 $\forall j(j \in J) : k=m+j$

The available time is now allocated such that the choices with lower k get more time.

If the time allocated to a certain choice is less than a certain limit the individual is deactivated from that choice.

The individual's problems related to a certain choice get a certain amount of that time which was allocated to the choice. The momentarily implemented distribution function gives the same amount of time to each problem of the same choice.

If a problem is attached to more than one choice, it gets time from all those choices. A problem is considered to be resolved by a certain individual if the time which has been allocated to it by the individual is equal to the necessary resolution time. Each time an individual is activated for a new choice a new problem resolution process is invoked.

2.4. Decision processes in a narrow sense are called each time a meeting of a decision committee takes place. For each choice that the decision committee is allowed to decide upon the resolution state of a choice is calculated taking separately all members of each political group which is represented in the committee together with individuals with a corresponding political attitude. The resolution state is calculated as the proportion of the time T_A actually spent by the individuals attached to the choice for the problems belonging to the individuals as well as to the choice to the time T_N necessary to resolve all these problems. Depending on the extent of the coordination T_A ranges from the maximum over the times that each individual has spent on the problems (no coordination) to the sum of all amounts of time spent by all individuals to all these problems (full coordination).

The decision process now distinguishes among collegial, majority, and time limit decision rules.

If a collegial rule prevails in the committee a decision is made if the resolution state of all political groups is greater than or equal to 1. If a majority decision rule prevails a decision is made if the resolution state of the majority is greater or equal to 1. The majority can be formed in two ways:

Either one political group has the majority alone or a maximum linked winning coalition (1) is constituted. Otherwise a decision is only made if a choice is present with a time limit that would be expired by the time of the next meeting or some other date.

The resolution state together with the corresponding problems are considered as a proposal to decide on the choice in a certain way and therefore as a proposal for resolution for the attached problems.

For collegial decisions the attached problem of all groups, for majority decisions the attached problems of the majority are considered to be resolved. For time limit decisions, a proposal of a political group PG is accepted with the following probability $P(PG)$

$$P(PG) = \frac{RS(PG) * ST(PG)}{\sum_{i=1}^{NPG} RS(i) * ST(i)}$$

with NPG: Number of political group present in the committee

$RS(i)$: Resolution state of political group i

$ST(i)$: Strength of the political group i

$$ST(i) = \frac{NMPG(i)}{NMCO}$$

with NMPG: number of members of political group i present in the committee

NMCO: number of members of committee

This takes into consideration the often observed situation that in cases where a full resolution is not present the influence of the majority can be reduced in favour of a minority which has achieved a high resolution state.

Consequences regarding the resolution of the problems are drawn not before the last responsible decision committee has decided upon the choice. In this case the following happens:

1. If a collegial decision has been made all problems attached to the choice are regarded as resolved.
2. If a majority decision has been made all problems of the members of the political group or of individuals with a similar political attitude are regarded as resolved. The problems of the minority are considered to be not resolved.
3. If a time limit decision has been made the chosen political group's problems are regarded as resolved with a probability PS equal to the average resolution state of that political group. With the probability of (1-PS) they are regarded as not resolved.

The resolved problems are removed from the corresponding individual's set of actual problems and filed into a set of old problems with the time spent on it equal to the necessary time for resolution but reduced by a certain factor SDISCT. The old problems serve as a memory which can be called if the same problem arrives afterwards. SDISCT takes into consideration the new circumstances which the old resolution has to be adapted to and the forgetting. The problems considered to be not resolved stay in the set of actual problems with the time spent on them also reduced by SDISCT.

The simulation starts with choices and problems filed into a particular instance of these assumptions at certain points of time.

LANGUAGE

The model was implemented in SIMSCRIPT II.5. The generally good support of this language was a little bit moderated by the incapability of entities to belong to more than one set of one class at a time. It was tried to achieve a modular design. The modules are formed especially under aspects of information hiding, therefore providing for a possibility of easy revision of some of the structural assumptions and most of the

behavioural assumptions.

4. GOALS, EXPERIMENTATION, AND VALIDATION

Although most of the experience has been drawn from universities, it is assumed that the basic assumptions also hold for other organizations. Till now goals, technology and participation were discussed more openly in universities with their more permissive structure. It is expected that, e.g. on certain levels of managerial reasoning in private firms, e.g. the level of strategic planning, in connection with a spreading right to participate in corporate decisions, very similar conditions of ambiguity and conflict will hold. The lack of awareness of the situation seems to be a matter of power to institute and to maintain a certain world-view. The concept of this model is therefore to be more general.

In the long run the model should help to design organizations, where under conditions of ambiguity and conflict and maximal freedom to participate there is simultaneously as much as is possible

1. a high participation of members in choices relevant for them
2. a high proportion of resolved problems compared to the number of problems which have been present in a certain time period
3. a high proportion of time left for non-choice processes i.e. no need for people who are exclusively concerned with decision processes
4. balanced decisions in the sense that it does not occur, that problems of some political or role groups are generally not resolved.

Many variations of the elements of the model are possible so that many actual and possible situations can be described and explored with this model, e.g.

1. variations of the decision rules in different committees
2. different numbers of political parties and different distributions of their strength
3. different role and political distributions of the members of the decision committees
4. different capacity of the organization or the political groups in terms of their time for choice process in proportion to the time necessary for resolution of the present problems
5. different degrees of coupling in terms of different numbers of levels of the decision structure to be passed by the choices
6. different distributions of entrance

time of the individuals

7. different distributions of members and entrance time of choices in relation to number and entrance time of problems
8. different distributions of time limits over the choices
9. different distributions of problems over individuals e.g. the same problems for all individuals, separate problems for each political group, overlapping problems with regard to different political or role groups
10. different distributions of the main concern of the choices with regard to political, or role, or formal group indicating the different problem perception by different role or political groups.

However, since theory development and corresponding empirical research in the area of organizational choice processes under conditions of ambiguity and conflict are still in their beginnings, it does not make much sense in trying to explore this model with full or fractional factorial experimental designs or response surface methods. Too many of the relationships of the model are only based on own observations and are not further validated. Some of the most critical and empirically hard to discover relationships are e.g. assignments of problems to individuals and to choices and to necessary resolution times, or the relationship of old to new problems. A more moderate approach was therefore chosen. At this stage of theoretical and empirical development the model only serves as a framework for both empirical and theoretical research.

For this purpose some simulations are run from time to time with its structure and elements as close as possible to a real situation which before has been analyzed empirically. (This has been done in 3 West German university departments for 4 years using own participation, observation, interviews and searching decision committee protocols.)

The protocol of simulation is then compared with the empirical results and it is seen what parts of the model seem to supply results relatively close to reality. In the course of modeling the development of a curriculum for a combined study of administration and informatics the model was able to reproduce especially well the communication and activation patterns of this choice, the long time passed before this choice - without time limit and with many associated problems - was decided, and the political outcome of the decision. Since the dynamic development of political attitudes is empirically hard to discover it is not possible to conclude from this good

result to other situations.

In addition to that there is another opportunity of getting confidence in the model. It serves currently as a guiding model for the empirical analysis of decision-making of West German university presidents. The important aspects are here the arrival of choices and problems at the presidents and the patterns of their activation and time spent on these choices and problems and the design of time budgets which generate efficient participation.

This is partly in line with the effort currently under way of analysing the model as a normative device for developing decision-making strategies under conditions of ambiguity and/or conflict. This analysis concentrates on the impact of different decision structures, role expectations, political structures, capacities, coupling structures, entrance times of members, structures of time-limits for the choices and relationships of problems to problems and problems to members on participation, problem resolution, time budgets, and political structure of the university personnel.

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