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Publication Date

1971-10-01

Peer reviewed

Reprint 107

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October 1971

University of California at Berkeley

\$8.50

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**University of California at Berkeley
Institute of Urban and Regional Development**

Reprinted from: *Bedrifts Økonomen*, No. 8, October 1972
(Norway).

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On the Planning Crisis: Systems Analysis of the 'First and Second Generations'

By Professor H. Rittel

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At the very beginning I would like to present some hypotheses about various systems approaches as they have been developed over the last two decades. The term 'systems analysis' means *attacking problems of planning in a rational, straightforward, systematic way, characterized by a number of attitudes which a systems analyst and designer should have.*

Characteristics of the Systems Analyst and Designer

First, his attitude should be somewhat *detached* from the problem at hand: he should try to be rational, objective and scientific in attacking his problems. Secondly, he is characterized by the attempt to *grasp the whole of the system* rather than someone who undertakes piecemeal improvement. And because the whole system has many facets and because the problems of planning are not the responsibility of any single discipline, the approach of the systems analyst and designer must necessarily be *interdisciplinary*. Some systems designers like to call themselves generalists in contrast to the specialist of a single

field. A fourth characteristic is that he is trying to *optimize*, i.e. to incorporate all relevant and important aspects of the planning problem at hand into one measure of effectiveness which he tries to maximize. The systems analyst deals with economics in the broad sense, not in the narrow monetary or budgetary sense: he is trying to maximize productivity in the sense of optimizing resource allocation. Of course the systems researcher is supposed to be *innovative*, i.e. to develop novel solutions from the formulation of the problem, or, as it is called, from the mission of the project.

Achievements of the Systems Approach to Date

Much hope has been placed in this approach and there are spectacular examples of the application of this systems approach. For example the NASA missions would not have taken place had it not been for the systems approach, nor would the big defence systems have existed. Further applications range from scheduling of toll bridges to the layout of a production-mix for a company. More recently proposals have been made to use this approach in other fields, for example in urban renewal, improving the environment, in tackling the nutrition problem of mankind, the health systems

and even the penal and law enforcement systems. Of great importance in this connection has been the computer which is supposed to make possible what could not be treated by the unarmed natural human brain.

Let us step back a little and look at this development in the retrospective. In general it can be said that the era of hope and expectation set into this systems approach has been followed by an era of disappointment. There is, particularly in the United States, a severe hangover about possibilities and usefulness of this type of a systems approach if applied to problems of the latter kind. In general it can be said without exaggeration that the classical systems approach has not yielded what was expected of it and in a number of large projects can only be considered as failures. There are furthermore indications that the confidence that this approach will be useful on a large scale and on many occasions, is diminishing; for example in the United States there have been cutbacks or even cancellations in the budgets of many of the large projects for applications of the systems approach. Many of the think-tanks and bodies which have been selling this approach to various governmental and industrial agencies are in a very bad shape and are reducing their size. There is

*) Foredrag holdt ved «Systems Analysis Seminar» i Karlsruhe høsten 1971 arrangert av European Association of National Productivity Centres i samarbeid med Studiengruppe für Systemforschung i Heidelberg.

among those people who can themselves 'systems researchers'. Those who have done this kind of work in the aero-space industry have lost their jobs by the thousands. After all it becomes evident that they are not at all the generalists who can attack any problems because of their approach but rather that they have become very narrow specialists in, for instance, missile guidance systems or in certain systems of spacemanship.

Before looking at the consequences of this development, I would like to analyse the *characteristics of the traditional systems approach* and why this approach has not worked as expected. For the sake of clarity I call this systems approach the *systems approach of the first generation* and I would like to contrast it with the systems approach of the second generation.

Steps in the First Generation Systems Approach

The systems approach of the first generation is characterized by a certain mode of procedure, by a certain sequence of steps or phases for attacking a planning project.

1. The first step, which has been given different names by different authors, is *to understand the problem*.
2. The second step is *to gather information* particularly to understand its context from the viewpoint of the problem. Then for some people (though others deny this) something happens called the 'creative leap', the great idea.
3. The third step is *to analyse the information*.
4. The fourth step is *to generate solutions*, or at least one.
5. The fifth step is *to assess the solutions* and to decide to take that solution which comes out best.
6. The sixth step is *to implement*, then
7. *to test*, and
8. *to modify* the solution, if necessary, and learn for the next time.

In different text books different names for these steps are found, but essentially they are the same, and there is no text book on systems methods which does not contain a first chapter describing these phases. *Operations Research* is closely related with a particular type of systems approach of this first generation with the following steps:

1. Define the 'solution space', this being a manifold of solutions, a set of variables, a combination of which make up the set of conceived 'of solutions'.
2. *define the constraints*, i. e. describe which of these solutions have to be excluded because they are not feasible
3. *define the measure of effectiveness*
4. *optimize the measure of effectiveness*, i. e. identify or search for that solution in the solution space which is within the boundaries of the con-

effectiveness assumes a maximum value. Usually it has to be demonstrated within the set of feasible solutions that there is no better solution than the one for which optimality is claimed.

These steps of OR can be applied to or substituted for the later steps of the general systems approach described above.

Shortcomings of the First Generation Approach: The Paradoxes of Rationality

I should like now to examine why this type of systems approach does not work for planning problems which are not found, as in the military domain, in the context of a strong autocratic decision structure as is the case for most problems of corporate and community planning.

The systems approach is based on a certain naive scientific idea that the scientist has, in addition to the traditional role of gathering or producing knowledge and offering this to the world, a further role of attacking practical problems and that the ideals and principles of scientific work are carried over into the context of planning. Why is it not possible to do this successfully in the context of the practical planning problems, corporate or other?

The most important reasons are *deeply lying paradoxes connected with the concept of rationality*. Rationality has many definitions and I shall choose a particularly simple one: *rational behaviour means trying to anticipate the consequences of contemplated actions*. In other words, think before you act. The systems approach of the first generation entails this obligation to be rational, which means that you try to understand the problem as a whole, and to look at the consequences. This is a rather modest definition, and there is hardly any reason to argue against it, because if a person would not try to be rational in this sense he would be irresponsible, not bothering about the consequences of his actions. Let us assume somebody seriously attempts to be rational in this sense. He would then try to anticipate the consequences of the alternative courses of actions: 'I can do this, or that, or that, but before I make my choice I must figure out what the consequences will be'. In doing this, he finds out that anticipating the consequences is consequential by itself because it takes time, labour and money to trace consequences, because it is work. Therefore, before I can start to trace the consequences of my actions, I should trace the consequences of tracing consequences of my actions. This is, of course, in turn consequential, because I invest time and money in tracing the consequences of tracing the consequences; therefore, before tracing the consequences of tracing the consequences, I should trace the consequences of tracing the consequences of tracing the consequences of tracing the



necessarily easier or simpler than the previous one, because the questions to answer become more and more fundamental. *Therefore there is no way to start to be rational: one should always start a step earlier.*

The *second paradox of rationality* can be demonstrated as follows: let us assume that somebody manages in some way to be rational. He is then in the middle of tracing consequences, which means that he comes to the insight that every consequence has consequences, which in turn means that there is no reason for him to stop at any point in time tracing the consequences, because every consequence can be expected to have further ones. Therefore, once he has managed to start being rational, he cannot stop it anymore, because he stops it only for extra-logical or extra-rational reasons, e. g. he has run out of time, money or patience. Yet from within the nature of the logic of the problem, there is no reason to stop the tracing of consequences. Therefore once it has been started it cannot be stopped anymore.

The *third paradox of rationality* is that the more one succeeds in being rational (and I assume that this is possible), the more it incapacitates one. This is so because the further one develops causal chains of consequences into the future, the more the effects of uncertainty will come into effect and the further into the future a chain of causal effects is developed, the less one can say which of these terminals will eventually become the case as a consequence of a particular course of action. This means that the better one succeeds in being rational, the less one can derive from that what one should do now. In the long run, we are all dead; it does not matter what we do now. Therefore, if we succeed in being rational it does not help us.

A *fourth paradox of rationality* is that of self-containment. In order to study the consequences of contemplated actions, a model (a causal description of the phenomena which are affected by the contemplated actions or affect the actions) is needed. Now this model should, because one is worrying about all consequences, contain and describe all those factors or phenomena which are important. But what is more important than the causal model itself which determines what can be traced as a consequence? Therefore the model should be part of the model, because it influences what can be figured out as a consequence. In other words, a model should contain itself, and that is impossible.

Wicked Problems and Tame Problems

These are the most serious objections to the systems approach of the first generation. Speculating about paradoxes is not a philosophical game but a matter of extreme practical importance. Let us look at it from another viewpoint by studying the *nature of planning problems* and contrasting them with the problems

chess player. I should like to describe and contrast two kinds of problems: the one is called '*tame*' problems (TPs) and the other the '*wicked*' problems (WPs).

Most research about creativity and problem-solving behaviour is about '*tame*' problems, because they are so easy to be manipulated and controlled. Unfortunately, little is known about the treatment of '*wicked*' problems or of people actually dealing with them, because '*wicked*' problems cannot be simulated in a laboratory setting. Yet all essential planning problems are wicked, whereas the systems approach of the first generation is good only for more or less tame problems (for instance a quadratic equation or a chess problem, or a problem of chemical analysis, or a problem of optimization of OR).

Properties of 'wicked' problems and 'tame' problems contrasted

1. The first property is that a tame problem can be exhaustively formulated so that it can be written down on a piece of paper which can be handed to a knowledgeable man who will eventually solve the problem without needing any additional information. This is not so with wicked problems. When I tell somebody the problem is that we need a management information system in our company or whether to introduce a new product into our production line, I can write it down on a piece of paper, give it to him and lock him up. But it will not be long before this person will come out again and ask for more information: what kind of a new product are you talking about? How will it affect the other production lines already in operation? What markets do you expect for your product? etc. You could say, that I could have listed this information ahead of time, anticipating that the man might need it. But the irritating thing is that, depending on the state of solution, the next question for additional information is unique and dependent on the state of solution you have already reached. For example, now you have developed your solution of introducing a new product to the point that you say: 'Alright, I want five machines of type 'A' which must be bought.' Then the next question depends on this decision, because it has, for example, to be determined whether the ceilings in the third floor can carry these machines. This is a question which you would not have asked if you had not decided to have these machines and to have them there. This question depends on your state of solution at that point in time and the next question could not be anticipated at the beginning by the formulator of the problem. In order to give exhaustive information ahead of time for a wicked problem you have to anticipate all potential solutions first in order to think up all questions which means that you do not have to

cause you can solve it yourself.

The first property is that *WPs have no definitive formulation*. This is a serious objection to the systems approach of the first generation, which has as a first step of the box-car train of phases 'understand the problem' before you go on and solve it. This consideration shows that you cannot understand the problem without solving it, and solving the problem is the same as understanding it. But how can you understand the problem if you cannot have sufficient information without solving the problem?

2. The second property in contrast to tame problems is that *every formulation of the WP corresponds to a statement of the solution and vice versa*.

When I say the problem is to get a machine carrying out a million operations, then this machine is a solution; if I say this machine should not be heavier than 500 kgs, then this is exactly the solution. This means that understanding the problem is identical with solving it. Whichever statement is made about the problem is a statement of solution. That is very different from tame problems, where one thing is the problem and another the solution, and very different from the notion of a problem as the proponents of the first generation approach had in mind.

3. The third property is that *there is no stopping rule for wicked problems*. If you have a chess problem made in three moves, then you know once you have found the combination of moves you are through with it and you have solved your problem; if you have an equation, and you have something like $x = y$, then you know that you are through. But this is not so with a wicked problem: you can always try to do better and there is nothing in the nature of the problem which could stop you. You stop for any planning problem, because you have run out of time, money or patience; but that has nothing to do with the logic of the problem, and you can always try to do better.
4. The fourth property: given the solution to a tame problem you can test it, assign to it either of the two attributes 'correct' or 'false' and pinpoint mistakes and errors. This is not so with wicked problems. The categories of true or false do not apply: we cannot say that this plant layout or a plan for a city is correct or false. We can only say that it is good or bad and this to varying degrees and maybe in different ways for different people; for normally, what is good for A is not at all good for B. This is the fate of all solutions to wicked problems: there is no criterion system nor rule which would tell you what is correct or false. I can only say, 'I think it is pretty good even if you say it is not so'. So: *to WPs correct/false is not applicable*.

haustive list of permissible operations. To take the chess problem as an example: at the beginning of a chess game you have a choice of twenty moves, and in chess it makes no sense to invent new moves during the game; or in a chemical analysis there is the choice of several hundred things you are allowed to do, though you are not allowed to tamper with the instruments or to alter the setting of a meter. But it is different again with wicked problems. There is *no exhaustive, enumerable list of permissible operations*; everything goes as a matter of principle and fantasy.

6. A problem can be stated as a discrepancy, as something as it is compared with something as it ought to be. The next consideration in problem solving of this kind is to ask 'why is it not as it ought to be?' and you look for reasons for the existence of this discrepancy, the cause and the explanation. And the trouble is that *in wicked problems there are many explanations for the same discrepancy* and there is no test which of these explanations is the best one. For example, if you say that our production is not efficient enough, you might decide that it is because our machines are too old, or because our scheduling system is not adequate, and you can try to find evidence for this; but you can also say that it is because the director of manufacturing is not the right person. Depending on which explanation you choose for the discrepancy, the solution will be led into different directions. If you think that it is the director's personality, then he will be fired; but if you think that the equipment is not adequate you will buy new equipment or look for possibilities for substituting for that equipment. The direction in which the solution goes depends on the very first step of explanation ('why is there a problem?'), which is the most decisive step in dealing with a wicked problem.

7. Every tame problem has a certain natural form and there is no reason to argue about, for example, the level of the problem. But *every wicked problem can be considered a symptom of another problem* and, of course, since nobody should try to cure symptoms you are never sure that you are attacking the problem on the right level, for curing symptoms can make the real disease worse. Therefore, never be too sure that you should tackle the problem as stated. If somebody says 'we have trouble in our inventory and we have delays due to inventory', we can always understand this as a symptom of, for instance, the general personnel policy or of the organization of the purchasing department. We should not conclude too early that we need to reorganize our inventory, for may-

be a comprehensive system. Every problem can be considered a symptom of another.

8. As I said before, the solution to a chess problem can be tested. For a wicked problem *there is neither an immediate nor an ultimate test* to the problem, because each action which was carried out in response to a problem can have consequences over time — next year there may be another consequence which contributes greatly to how you assess your plan. There is no time limit for the potential consequences of a problem, and therefore there is no ultimate test, because there can always be additional consequences which might be disastrous and which result from what turns out to be a very bad plan.
9. A chess problem can be played over and over again; if an equation is not solved at the first attempt, try again; it only takes a bit of paper, a pencil and time. If you have solved one quadratic equation, you have solved them all because the trick of solving one is the trick of solving the whole class of equations of the second degree. There are prototypical solutions for all classes of tame problems. However, one can only anticipate or simulate potential consequences to a certain extent in order to get an idea whether something is or is not a good response to a wicked problem, for a wicked problem cannot be repeated. *Each wicked problem is a one-shot operation*. You cannot undo what you have done in the first trial; each trial matters and is very consequential: you cannot set up a factory, see how it works, demolish it and rebuild it over again until it works. *There is no trial and error*. There is no experimentation in dealing with wicked problems.
10. *Every wicked problem is essentially unique*. This is very irritating because you cannot learn for the next time; you cannot easily carry over successful strategies from the past into the future since you never know whether the next problem does not have a characteristic, a property, which is sufficiently different from the previous problems to make the old solution no longer work. Seemingly similar problems ask for transfer of a solution from one context to another and only a closer analysis shows that there are other factors which are so important, distinct in both these situations, that such a transfer is inadvisable. In the treatment of wicked problems you should never decide too early what the nature of the solution should be, and whether an old solution can be used again in a new context.
11. In contrast to the tame problem solver who may lose or win a chess game without being blamed for it or may state a wrong hypothesis which will be refuted by someone else, *the wicked problem solver has no right to*

The Consequences of these Properties of Wicked Problems for the Systems Approach

If you remember the box-car train of steps or phases given earlier and compare it with the eleven properties of wicked problems, then you will see that there are various contradictions which are responsible for the uselessness of the first method approaches to wicked problems — *and all our problems are wicked*.

The first step was 'understand the problem'. But according to properties 1 and 2 of our list you cannot understand and formulate the problem without having solved it. If we cannot understand a problem, step 1 cannot be carried out without having gone through step 6 in the old list. So you cannot get information without having an idea of the solution, because the question you ask depends on the nature of solution you have in mind.

Then the generation of a solution manifold is not a separable step: it goes on all the time. With the first step of explaining the problem you already determine the nature of the solution. The first statement of problem is already a statement of solution. You cannot separate the generation of solutions from understanding the problem etc. You can play this with all these eight steps of the first-generation approach and I claim that there is sufficient evidence to reject the first-generation systems approach for the treatment of wicked problems.

Let us now look at Operations Research which is connected with this approach and in which there are also various steps: determine the solution space, determine the measure of effectiveness, determine the system of constraints, etc. Once all this is done, OR starts: you start to optimize, using linear programming etc. This means that information gathering has to be carried out before OR can start. But is not the generation of this information (which solution shall I consider as alternative, what shall be considered good or best, and what are the constraints of my problem?) the difficult question? Once you have answered this question most of the problems have been solved, and what is left over is a search process for a well-defined optimum. But OR starts once the wickedness is out of the problem, once you have said what a good admissible, feasible solution is. You can say, 'Constraints are naturally given.' But that is not so. Every constraint represents a decision, mainly a decision of resignation. To give an example: a company producing pre-fabricated parts for building wants to transport these on trucks. The trucks have to cover a certain area. The lowest underpass in that area determines the maximum height of truck plus component. That is a constraint: truck, loading surface, plus height of the component should not

the critical underpass: you could raise it somewhat if it is important enough to make the component a little bit taller or higher. It may pay off to carry the component over the underpass with helicopter or to lift the underpass somewhat. It is by no means a natural constraint; it is only that you resign yourself to the irremovable existence of a critical circumstance. The constraint is not at all a technical and objectively given logical entity; *every constraint or limitation I pose on my action space is a decision, or at least an implicit indication of resignation.*

Some Principles of the Systems Approach of the Second Generation

1. The knowledge needed in a planning problem, a wicked problem, is *not concentrated in any single head*; for wicked problems there are no specialists. The expertise which you need in dealing with a wicked problem is usually distributed over many people. Those people who are the best experts with the best knowledge, are usually those who are likely to be affected by your solution. Hence, ask those who become affected but not the experts. You do not learn in school how to deal with wicked problems; you learn something about inventory systems, about Operations Research, or about manufacturing technology, but not the appropriate thing to do in a particular setting of an organization. (I exaggerate deliberately.) The expertise and ignorance is distributed over all participants in a wicked problem. There is a *symmetry of ignorance* among those who participate because nobody knows better by virtue of his degrees or his status. There are no experts (which is irritating for experts), and if experts there are, they are only experts in guiding the process of dealing with a wicked problem, but not for the subject matter of the problem.

2. The second principle of the second generation rests on the insight that *nobody wants to be 'planned at'*. The most dramatic examples for this are the American urban renewal projects where people revolt against being planned at. The buildings which are constructed can be as nice and inhabitable as you want, but the fact that they have been imposed from top makes them obsolete. The consequence of this is that planning methods of the second generation try to make those people who are being affected into participants of the planning process. They are not merely asked but actively involved in the planning process. That means a kind of *maximized involvement*. And this seems to be the case even of corporations that the planning from top (imposed planning) becomes less and less popular.

blem, at every single step a judgement is made which is not based on scientific expertise. There is always an 'ought-to-be' statement involved. For each step there is a conclusion which ends with 'do this and that'. This is a so-called '*deontic premise*', i.e. a personal premise of the 'ought-to-be' nature which is not justified by professional expertise but is only an indication of political and general moral and ethical attitudes. Therefore, if you look only at the outcome of the planning process, you cannot reconstruct which deontic statements have entered into the argument leading to the solution. Therefore you can no longer control the wicked-problem solver because of all these more or less implicit deontic assumptions he has made on the process he was going through. If this is so, then on the one hand there is one more reason to have others participate in order to bring out these premises and, on the other, there is the need to look for methods which show some *transparency of the planning process*. These methods should lead to a situation where every step of the planning process is understandable and communicable or 'transparent'.

4. As has already been said, an essential characteristic of wicked problems is that they cannot be correct or false, but only good or bad. But who says whether a plan and the solution to a problem is good or bad? In fact everybody has the authority to say if he is being affected positively or negatively by the plan and there is no way of saying that A's judgement about this plan is superior to B's judgement. There is no authority to say that, because there are no experts anymore. (This is different from the doctor's situation, for he is an expert.) If A says it is a grand plan and B says it is lousy, who is right? Therefore we should draw the conclusion and say, 'everybody is entitled to exert his judgement about the plan'. We need procedures which enable us to explain to each other why I think that it is great and you think it is lousy.

Many methods deal with the problem of helping the process of making the basis of one's judgement explicit and communicating it to others. We call this process '*objectification*'. This differs from making something objective, because making something objective in the scientific sense means that you invent a procedure, the outcome of which becomes independent of the person who carries it out. For example, you say in measuring technology you have succeeded in making a thing objective if it does not matter who carries out the measurement. We talk about an objective situation or an operation leading to objective statements: the less it matters who carries it out the more objective the outcome would

the statement, or who goes through the planning process. We can never be objective in planning in the scientific sense and therefore there is nothing resembling scientific planning. This is very different from carrying out science, because it matters who carries out the process and who is involved; by 'objectification' we mean that we must successfully exchange information about the foundations of our judgement. If you can tell me why you say that plan A is great, and I understand your judgement, you have succeeded in objectifying your space of judgement to me. And although I might not share your judgement and might not be convinced, I understand you now. The systems researcher of the second generation hopes that better mutual understanding of the bases of judgement of others at least does not make it less likely that people come to an agreement. More deliberation does not lead to agreement, though it may lead to understanding; one cannot enforce agreement, but the likelihood of agreement and the effect of learning from each other is greater.

The hope in this process of objectification is:

- to forget less: if you tell me your version or story, maybe I forget less than I would otherwise.
- to stimulate doubt: if you have to tell your story it is likely to stimulate doubt, and this is good because only doubt is a test of plans.
- to raise the right issues: objectification will help you identify those questions which are worthwhile, which have the greatest weight and where there is the greatest disagreement. If we agree, we do not have to discuss or analyse something. If we disagree considerably and it is important we have to discuss and analyse it.
- to control the delegation of judgement: if I let you plan for me, then you had better objectify to me how you proceed, because I want to have some control about the delegation of judgement.
- the belief that explicitness is helpful which is not so in all matters of life. There are some situations where we had better not be explicit.

5. Another principle of systems approach of the second generation is that there is *no scientific planning*. After these considerations it is pretty self-evident, but people often talk about 'scientification' of planning (dealing with practical problems in a scientific fashion. Dealing with wicked problems is always political. There is not that detached, scientific, objective attitude in planning; it is always political because of these deontic premises.

sees his role as somebody who helps to bring about problems rather than as one who offers solutions to problems. He is a *mid-wife of problems* rather than an offerer of therapies. He is a teacher more than a doctor. Of course, it is a modest and not a very heroic role that such a planner can play.

7. Another characteristic of this man is that he *makes careful, seasoned respectlessness*, i. e. casting doubt on something, a *virtue*. Although he knows his dilemma of rationality and the nature of wicked problems, he must be at least moderately optimistic. Moderate activism and optimism in part of his attitude. He knows that responsible planning is important, because one cannot be rational: on the other hand one is obliged to be rational, although it is impossible, which is a difficult situation. Either one must give up the treatment of wicked problems and of planning altogether or one must come to the conclusion to try something in any case.
8. *Moderate optimism*, a further characteristic, has been mentioned above.
9. The model you might use instead of the expert model of the first generation can be called a *conspiracy model of planning*. This means that, because we cannot anticipate all the consequences of our plans, every plan, every treatment of a wicked problem is a venture, if not an adventure. Therefore, let us share the risk, let us try to find accomplices who are willing to embark on the problem with us. For one person it is too risky, but maybe if we join our forces we may take the risk and live with the uncertainty and embark upon the venture. This seems to be a somewhat tenable position to justify the courage in planning at all.
10. Whereas the planning process of the first generation can be carried out in solitary confinement with long sequences of steps where you can proceed according to the rules of the art, the *planning process of wicked-problem solving must be understood as an argumentative process*: one of raising questions and issues towards which you can assume different positions, with the evidence gathered and arguments built for and against these different positions. The various positions are discussed, and after a decision is taken one proceeds until the next question arises within the process. For instance, the issue could be the location of a plant. You can, of course, take the view that this is the wrong question, that one has to discuss first of all whether one should build a plant at all. Let us assume, however, that we say 'yes, we want to build a plant'. There might be three possible locations. We can then collect or set up the different positions for and against these three locations and then arrive at an argu-

be the best. Once we have made up our mind as to which one to assume as the best, we go ahead. Shall we make it a one or a two-storey building? — so the whole thing starts all over again. Each question of decision can be combined with an argument and actually we do this all the time: we deliberate our judgement and what is deliberation other than identifying and weighing pros and cons, simulating debates and arguments in your head? Systems methods of the second generation are trying to make this deliberation explicit, to support it and to find means in order to make this process more powerful and to get it under better control. Planning is an argumentative process.

These are the main principles of the planning process of the second generation, particular versions of which are described in this report.

The Intuitive versus the Research Approach to Planning

I hope I have shown that you cannot be rational in planning: the more you try, the less it helps. On the other hand, this does not imply that you should do whatever comes into your mind, based on intuition. Certainly that is not the conclusion one should draw from this. There is actually no polarity between what you might call an intuitive approach to problem solving and on the other hand a controlled, reasonable, or rational approach. The more control you want to exert and the better founded you want your judgement to be, the more intuitive you have to be. Let me demonstrate this.

We can look at the *planning process as a sequence of events*. For example, whenever you tackle an activity for which you are very experienced, you go ahead by what you might call a routine or rote process — whenever you think that somebody has style, that means that he has well developed routines.¹

Now let us look at another type of problem solver. Here the man runs into a problem and he does not see any immediate way out. He then *scans his mind for a way out*, and he gets his first best idea (and usually we try the first idea assuming it is the best). Then he goes ahead and runs into the next problem. Maybe he has to scan a long time until he finds the next best idea, etc. Now, it may happen that scan as much as he might, he runs into a deadend. What does he do in such a case? Either he keeps scanning and tries to generate a potential way out or he avoids this problem and goes back to the previous problem and decides that the solution was not so good after all because it led him into a deadend. Therefore he should look for a second chance and pursue this one in order to avoid this deadend. And I would say that most of our practical problem solving behaviour is of this type.

The third approach is that the man

¹) Style and routine are the same. Style is no longer necessary to solve problems; it is usually an indication of age.

out. But before he pursues his first idea he *develops a whole set of alternative ideas* and looks for reasons to exclude all except one. He does this by constructing filters of criteria through which he passes all these alternatives, i. e. he uses all the aspects in assessing the merits of the various alternatives with the hope that one passes. He then goes ahead until he runs into the next problem. Certainly in this case we have fewer feedback loops than in the previous case because we check more things before we go ahead. What can happen in the ideal case is that only one solution passes. At the other extreme many will pass and then you either choose at random, for instance by tossing a coin, because all the reasons you have for choosing one or the other are incorporated into these criteria, and there is therefore no good reason any more to prefer this one or that one; or you find additional criteria until only one solution is left over. The third and very frequent case is that none of the alternatives passes: the criteria are contradictory or no solution happens to be good enough. Then you either quit and say there is no solution to this problem, or you generate more solutions. You could also relax your criteria saying that you should not ask for too much.

There is a fourth possible approach: that you begin to develop alternative courses of actions, but before you move or make your choice, you see which next actions you can take, like a chess player who tries to think several moves ahead. You take a big battery of criteria, and then hopefully some alternatives, the best ones, will pass, and then you proceed with the same argument as before. If I could do this over the whole span of the problem, I would not have any loops any more. The trouble is that this process proliferates into tremendous numbers of possible courses of actions and is no longer very handy.

The 'rational' man tries to develop a style more of the fourth than of the second type and you can see that this process can be regarded as consisting of two alternating basic activities. One is what you might call the *generation of variety*, i. e. having ideas to develop courses of action and ideas of solution. The other one is a *reduction of variety* which means constructing evaluation filters. The hypothesis of the second generation of systems analysis is: to generate variety, to have ideas, is the easiest thing in the world; even a computer may be capable of helping there. However, it can do nothing in the second part, that is in the reduction of variety, which is essentially the same as the exertion of judgement.

To show the complementarity between the intuitive and the systematic, a short look is needed at the *structure of judgement*.

There are various kinds of judgements. If somebody asks you how you like the soup, it does not take you a moment to say whether it is good or bad. These are

what we might call *off-hand* or *intuitive* judgements. On the other hand you might say, 'Wait a minute, I must first think about it', and look for the pros and cons before you make up your mind and say whether A is good or bad or whether A is better than B. These are *deliberated judgements*. The deliberated judgements are substitutes for the off-hand judgements. You make a deliberated judgement because you do not trust your off-hand judgement. You would say off-hand, 'I think it is okay but I should like to check it'. Another and also very important opportunity for deliberation is that you have to explain your judgement to somebody else. You say, 'I think it is great'; the other person asks 'why?' and you have to deliberate your judgement in order to explain to somebody else why you arrived at this judgement.

Another distinction is between *overall* (final) *judgements* and *partial judgements*. Each solution has certain virtues and certain disadvantages compared with the other solutions. But you have to come up in the end with an *overall* judgement. You have to make a decision: X and Y is good or plan A is the

best or is sufficient. If you cannot make an off-hand judgement, you must deliberate before you say whether for instance plan A is good enough, i. e. you must look for the reasons contributing to the quality or the performance of A, and these reasons are X1 (capital costs), X2 (maintenance costs), X3 (safety), etc. You must judge the object under all of these aspects independently and you must in some way integrate all these partial judgements into one judgement, the overall judgement. But you may want to deliberate even further. For instance, you may be unwilling to make spontaneous judgement on capital costs and distinguish instead between construction costs X11, site costs X12, roofing costs X13, etc. and make partial judgements on these. And then you must bring these second-order partial judgements together again into a partial deliberated judgement on capital costs which in turn contributes to the overall deliberated judgement whether plan A is good enough or not.

The point I want to make here is only that the more you try to deliberate, the less you trust your off-hand judgement. If you want to base your judgement on

looking at all the pros and cons very carefully, the more you do it the more of a tree you get. The more systematic you want to be the less intuitive or off-hand you want to proceed. But the terminals are always off-hand judgements. This means that the more systematic you want to be and the less you trust your off-hand judgement, the more off-hand judgements you have to make. This is the point I wanted to make with regard to the correspondence between these two styles of judgements.

Let me summarize. What I wanted to do first was to demonstrate that the systems approach of the first generation, which all of you know, is not suitable for attacking planning problems of your kind. The second point was to show that there are reasons for the failure of these procedures: on the one side, the dilemmas of rationality, and on the other, the wicked nature of problems. The final part demonstrated the characteristics of approaches of the second generation, the assumptions made and the foundations of the systems approach of the second generation.

