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On problem solving and control*

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report no. 35
Introduction

I am glad that professor Checkland asked me to present a short contribution to this fine workshop on problem solving. My contribution will be based upon a part of my paper presented in the symposium on management and cybernetics [1] and on work going on at Eindhoven in the field of problem solving. Mr. Kramer in our group is working on a dissertation in this field and we together prepared a report on problem solving [2] which unfortunately is in Dutch. Today I will briefly present some of the views we held on problem solving.

Central ideas

We start from some four central ideas:
1. Systems theory has to be useful for management and organisation.
2. Problem solving is an important part of management and organisation.
3. In the literature several views on problem solving methodology are reported.
4. Such a methodology could perhaps fruitfully be based upon systems theory especially the cybernetical part of it, the science of control.

I believe that these ideas are very much alike those we heard from the main contributors to this workshop.

From these central ideas I will proceed further by devoting attention to problem solving, the task of a problem solver, the paradigm of control and finally to a methodology of problem solving.

Problem solving

In our approach to problem solving we do not conceptualise a problem as some objective property of a system. We hold a behavioral view. A problem is a subjective state of unhappiness. It therefore is indissolubly attached to a problem-owner, which may be an individual or a group.

A problem owner now might be seen of as a controller of its environment. A problem is a subjective state of unhappiness of some problem owner. Therefore it is clear that any problem is caused by one or more of three interrelated factors: The perception of the problem owner of his environment, his goals and finally the "objective" reality*.

* I will not dwell upon the philosophical problems about the concept of reality.
Symbolically one may write:

\[ \text{Problem} = F (\text{goals, perception, reality}). \]

Clearly when there exists a problem, and this means that a problem owner, someone who feels unhappy, can be identified, the problem solver (which might be the same person or group) can start to solve it. On the other hand however, if nobody is unhappy, there is no problem. In those cases any problem solving activity should begin with the generation of a problem. That is one should select a potential problem owner and make him unhappy. There are two important reasons for our subjective definition of a problem: a definitional one and also a practical one. I will not argue about the definitional reasons. As far as the practical reasons are concerned I only have to recall the well known fact that people most likely are willing to cooperate with a problem solver if they feel unhappy and believe that their cooperation will make disappear their problem. If they are not unhappy they mostly are not willing to spend much time to it. When for instance in a factory there is a very high turnover rate which does not alarm the manager at all then this manager has no problem. And when you want to solve the problem you think this manager should have than clearly the first step is to create this problem, that is make the manager feel unhappy with this high turnover rate.

A consistent elaboration of this view is possible but would exceed available space.

The task of a problem solver

Problem solving is influencing a problem owner in his environment in such a way that the problem (hopefully) vanishes. The problem of judging a methodology, which was raised by professor Checkland, therefore is not possible in any strict sense. Problem solving is an activity of a problem solver, with the help of a methodology, to influence a problem owner in a specific environment. The solution of the problem is a result of the interaction between four variables: problem solver, problem solving methodology, problem owner and environment. These four comprise a system. One may say that a problem is
solved, but cannot easily conclude that "it was the methodology" which did it or, to take another example, that it was the incompetence of the problem solver which prevented the methodology to lead to the desired result.

The task of a problem solver, as I already indicated, is to take measures to eliminate the subjective state of unhappiness. This means that he should exert influence in a directive way. And this is control.

One should notify that the concept of control we refer to is a very broad one: Any way of directive influencing is control.
(f.i. teaching, convincing, ordering, asking, etc.)

With this broad concept of control in mind we may say that problem solving is control and a problem solver is a controller.

Paradigm of control

The importance of the concept of control in the realm of problem solving now may be plausible enough so that I will direct attention to the main ideas of the paradigm which is described in more detail in my paper for the symposium on management and cybernetics [1].

In a logical order the paradigm of control discusses three aspects.

1. The problem of control.
   By definition a problem of control consists of the specification of
   1.1. - the system to be controlled
   1.2. - the goal of the system
   1.3. - the disturbances to be expected.

2. The solvability problem.
   The solvability problem comprises two aspects:
   2.1. - the controllability problem
   2.2. - the control characteristic.

3. The design of the controller.
   In this third fase we can make use of system theoretical ideas about the requisites for a controller (as f.i. Ashby's law).
The Methodology

The methodology of problem solving is in fact nothing more than the iterative application of the afore mentioned three steps of control.

Just to give an impression of how it works I will present the start of a problem solving sequence for a situation where there exists a problem. I want to recall that the problem solver is seen of as a controller of a problem owner in its environment as is pictured in the following figure.

![Diagram of problem solver as a controller](image)

Figure 1. The problem solver as a controller.

By iterative application of the steps for control we get.

1. Problem of control.
   1.1. Specification of the system.
       In problem solving terms: Identify the problem owner.

   1.2. Specification of the goal.
       In problem solving terms: Eliminate unhappiness of problem owner.

   1.3. Specification of disturbances.
       In problem solving terms: Specify the environment of the problem owner.

2. Solvability problem.
       In problem solving terms: Does the problem solver thinks he is able to solve the problem? Is he the right person to do the job?
2.2. Control characteristic.
In problem solving terms: In what ways the system can be influenced?

3. Design of the controller.
In problem solving terms: Decide upon the control mix. That is look whether one should focus upon the problem owner (its perception or goal), on the environment (reality) or the interrelation between problem owner and environment.

Now suppose we decided that the problem is caused by some factors in the environment and not by the problem owner.
This means that the attention of the problem solver is directed to a part of the system he started with. And, compared with figure 1 we get the situation pictured in figure 2.

Then the next iteration of the three steps of control can be made:
1. Problem of control.
   1.1. Specification of the system.
   In problem solving terms: Specify the environment of the problem owner as a system, e.g. a warehouse.

   1.2. Specification of goal.
   In problem solving terms: e.g. lowering down inventories.

   1.3. Specification of disturbances.
   In problem solving terms: Specify demand, delivery etc.
2. Solvability problem


In problem solving terms: Am I the right problem solver for this inventory problem?

2.2. Control characteristic.

In problem solving terms: Specify the ways the inventories can be influenced e.g. by marketing, by planning production, by recordering policy's, etc.

3. Design of a controller.

In problem solving terms: In which direction we are going to look for a solution for the problem e.g. are we going to define it as a problem of marketing, of planning, of production etc.

After a decision is made the sequence starts again.

I will not proceed further. Nevertheless I hope that you have an impression of the way we are working at Eindhoven. In any event you might understand that I feel quite at ease in this workshop where the theme of control is so a dominant one as is exemplified by the papers of Dr. Malik, Dr. Gomez and Dr.Oeller and also in the introductory talk of professor Checkland.

[1] De Leeuw, A.C.J.

The control paradigm as an aid for understanding and designing organizations.


"Probleemoplossend onderzoek, een benadering vanuit de systeemleer".