Soft systems methodology

Once we think to have a good idea, the next step becomes to translate that idea into an idea that can be communicated to other people (inside or outside your team). The aim of this phase is very much to make the mental picture clear behind the idea, in order to clarify it, but equally in order to make it easier to communicate. A well-known method for supporting this transformation is called soft systems methodology (SSM) and it is successfully used in the pre-phase of IS design. A workshop in the MBI&I will give particular attention to this approach, but this project is a perfect chance to test things already out. The basic idea behind SSM is the one of systems thinking about the real world.

What SSM aims for is to translate perceived problems, ideas, issues, etc into activities than can be dealt with easier, that are more grounded into the real (corporate) world. It uses activity systems in which actors, aims, activities, transformations, etc are identified. Therefore, the method has not only been used for preparing IS development projects, but also in situations where clarification of vaguely felt issues was difficult but important. That is what we propose to use SSM here for.

The following diagram pictures the process. SSM consists of three steps. The first step, that might already been taken in the brainstorm phase, is the drawing of what they call are **'rich pictures'**. Drawings that illustrate the idea and some the actions that are part of it. It can be compared with simple maps of ideas. SSM has a particular 'code' in order to make these rich pictures. Here are some examples to illustrate.

Examples 1: Rich pictures

Extract 1 Pears soap

Pears transparent soap, which is expensive, is made by dissolving soap in alcohol and allowing the alcohol to evaporate slowly. This is done in moulds which are the shape of the bars of soap: the natural shape achieved when the solvent evaporates is the oval with the characteristic depression in it. The economics of the process depend entirely on recovery of the solvent for recycling. At least 98% has to be recovered if the process, which is in any case slow, is to be made economic: hence the alcohol recovery has to be carefully monitored.

The picture corresponding to this extract is given in Figure 2. The picture is essentially in two parts. The extract describes a 'process' and the upper part of the picture is a process description. We are also told something about the process and so the lower part of the picture identifies the three features as the process characteristics. The above extract is a fictitious example used to provide a simple illustration. A more complex example is given in the second extract and this is also fictitious.

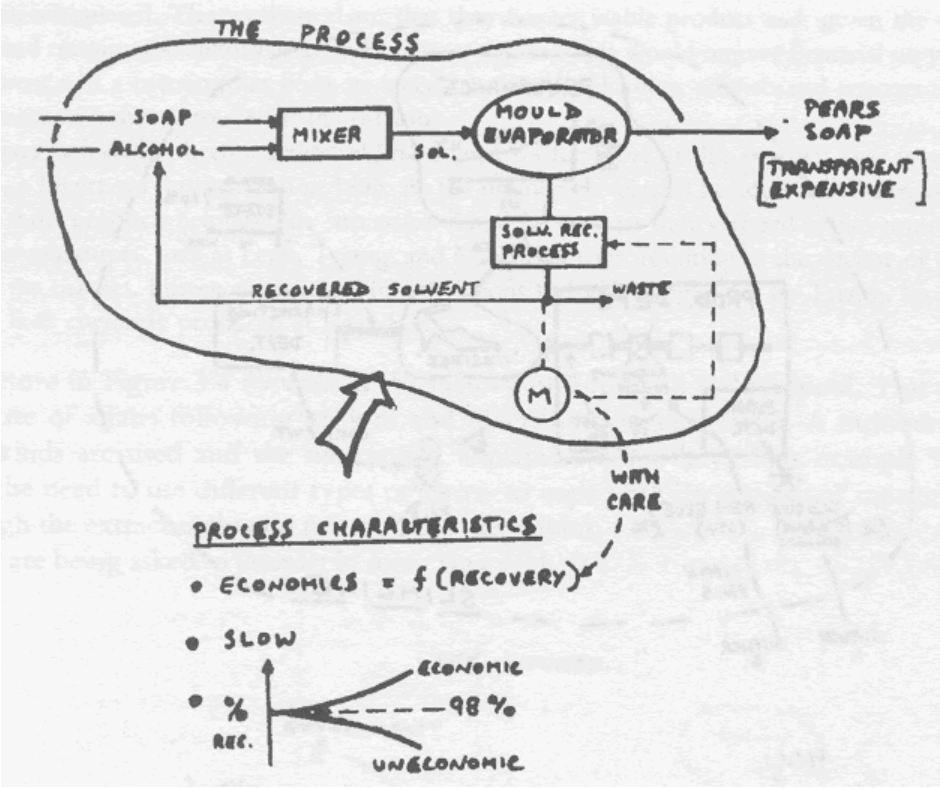


Figure 2: Rich picture for Pears soap

Extract 2 Slimline shoes

'Slimline', manufacturer of women's shoes, are hoping to improve their performance with a new range called 'Carefree'. (From a peak return on capital of 22% three years ago they have fallen to 15% then 11%.) The Managing Director discovers that the Production Department has introduced a new glue for sticking soles to uppers. This eliminates a sole-roughening process and has enabled them to achieve an 8% reduction in production cost. The MD, however, when investigating a Marketing Department complaint that for the last two weeks they have been 20% down on the supplies of shoes they need from production, finds that the glue is in short supply. It seems that the Purchasing Section of the Production Department has cancelled an arrangement by which they receive an 35% discount on bulk supplies of the original glue (this discount could not now be reinstated) and are buying the new glue ('STIX'), at the same price as the old glue, from a different supplier, who has failed to meet delivery promises.

Figure 3 is the rich picture corresponding to this extract.

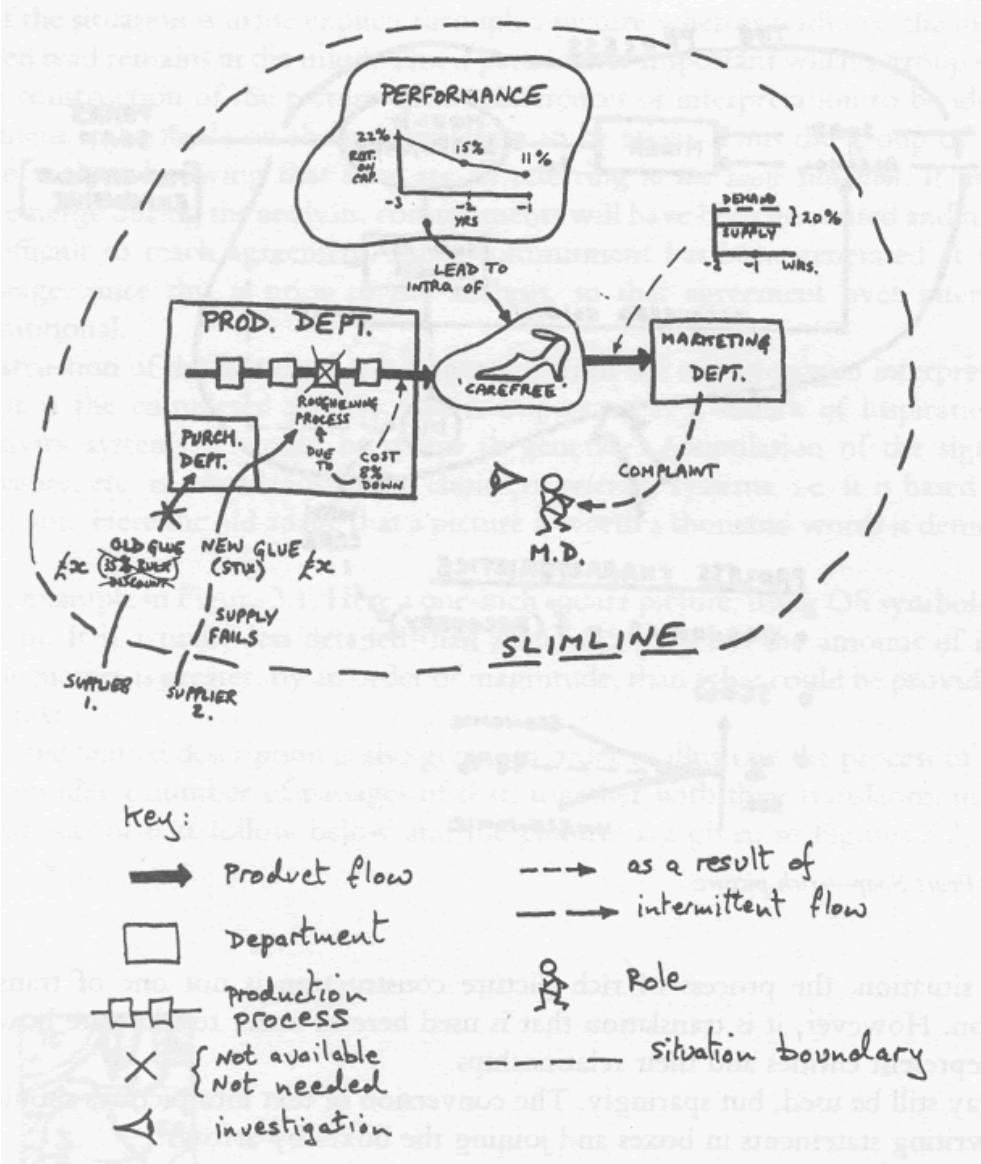


Figure 3: Rich picture for Slimline shoes

The final example is represented by an actual extract from a national newspaper.

Extract 3 Meccano

The workers at the Edge Hill (Liverpool) factory of Airfix industries are currently staging a 'work-in'. This particular factory produces Meccano, the traditional construction toy, and Dinky Toys, which range from model cars through all varieties of vehicles to agricultural implements. The situation has arisen because Airfix have stated their intention to close the factory, making some 940 workers redundant. Very little investment in new machinery has taken place over the last 50 years, resulting in production methods which are antiquated. The workers claim that they have a viable product and, given the opportunity, they intend running the factory as a workers' cooperative. This would require financial support from the government and a meeting has been arranged between local union officials and representatives of the Department of Industry to discuss the situation.

Meccano, which has been a household name in toys for most of this century, was invented by J.F. Hornby, a Liverpool businessman in 1893. As the business developed, he added model trains and Dinky toys all three products being highly successful. After the last war they suffered fierce competition from other manufacturers, such as Lego, Triang, and Matchbox toys, resulting in the decline of the Meccano share of the market. Fifteen year ago, Hornby Trains Ltd. was bought out by Triang, leaving the two product lines currently produced at Edge Hill.

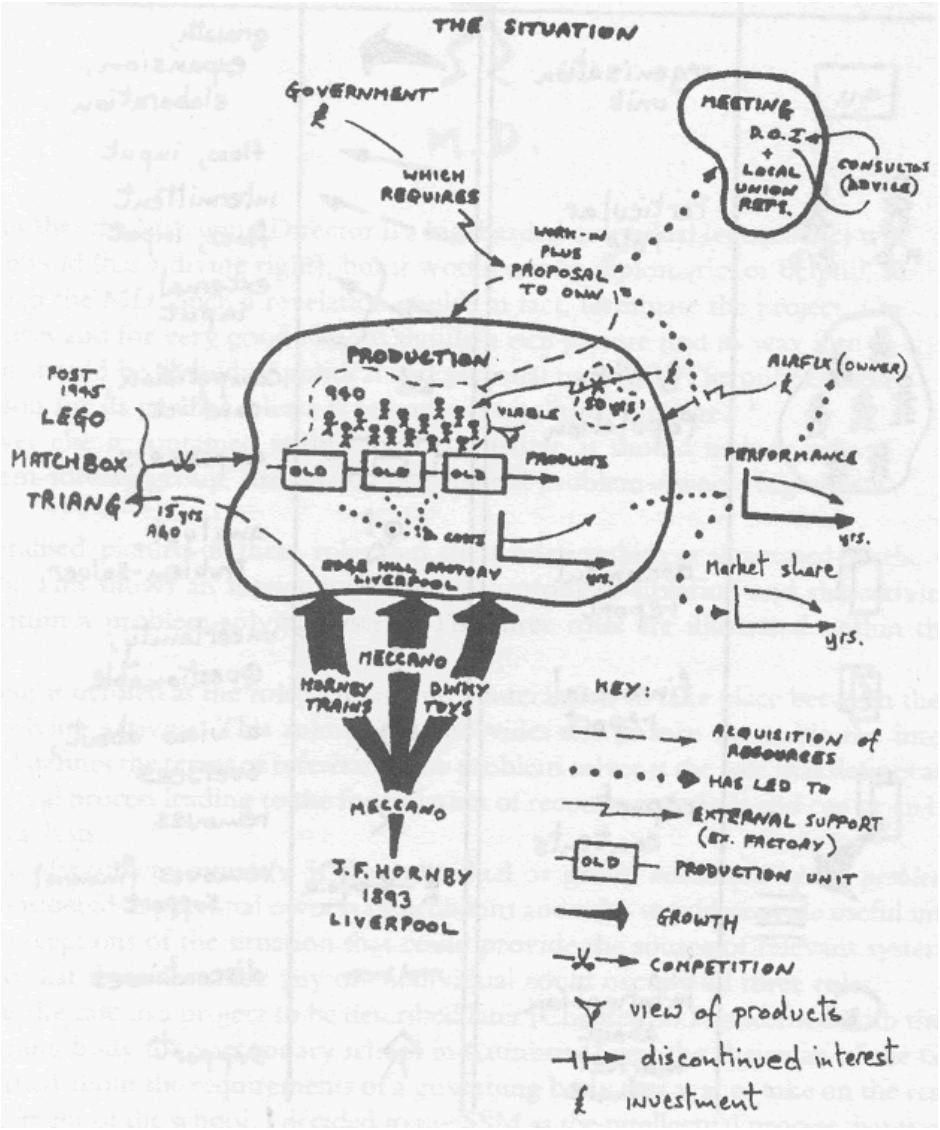


Figure 4: Rich picture for Meccano

The picture in Figure 4 focuses on the factory of Edge Hill in Liverpool. This represents the current state of affairs following growth and diversification since 1893. A number of arrows of different kinds are used and the meaning is explained in the key. This example is intended to illustrate the need to use different type of arrows to cope with the variety of meaning.

Although the extract makes no mention of a consultant, one has been included to make the point that, if we are being asked to interact in some way with an organisation, we should include ourselves in the picture. We are part of the situation and our relationship to it is important. This illustrates that the consultant has been brought in by the Department of Industry (DOI) with the terms of reference: to provide advice to the meeting. Thus, including the consultant (or ourselves, as consultant) we make clear who the client is and their expectations of us.

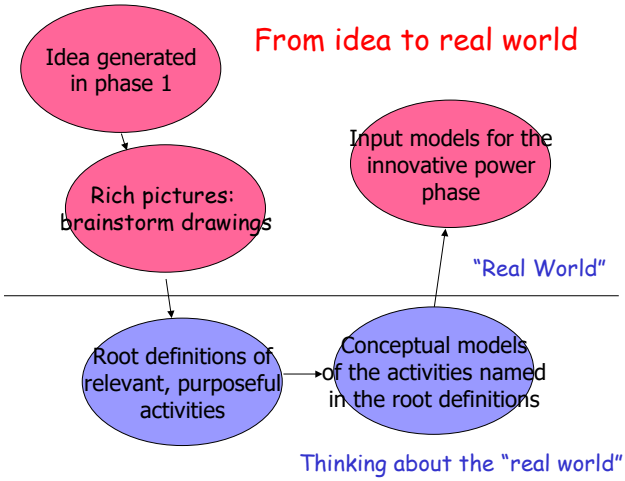


Figure 5: From idea to real world

In the next step we start thinking about the real world, using some structured approach. The Rich Pictures are translated in **root definitions** (RD) that describe the essence of the purpose to be served. Each root definition is one sentence, in which the verb gives the transformation. A root definition consists of six elements that form the acronym CATWOE.

C: Customer (the recipient of the output of the transformation, the victim, the beneficiary)
A: Actors (individuals that would do the activities in the resultant conceptual model)
T: Transformation process (input-output conversion)
W: Weltanschauung (statement of belief about the purpose, aim, wider good, the world)
O: Owner (wider-system decision taker with authority over the system defined)
E: Environmental constraints (external to the system defined)

CATWOE is defined within a framework of (corporate and/or IS) development. Therefore, some of the elements of CATWOE might seem at first odd. However, in order to translate an idea into a real-world situation, one should also think about the actors that eventually will execute things, the owners (Management Team, or an outside entity) that should support the development and give the go-decision. There is no need to stick very close to the given labels; there is however a need to identify all elements and bring them together into an activity.

Here are some examples of root definitions

Examples 2: CATWOE and root definitions

Many examples exist in the literature related to SSM (soft system methodology) which illustrate incorrect usage of CATWOE. A few are used here to illustrate various aspects of the relationship of CATWOE to a RD taken mainly from student practice. The example is given followed by a brief description of the faults.

Example 1 Related to a RD representing a manufacturing company

RD A system to manufacture and sell a specific range of products at minimum cost in order to make a profit.

C The market
A Production Department and Marketing Personnel
T manufacture for sale
W MD
O not specified
E profit

This example is probably the result of the casual application of the CATWOE test. The RD (root definition) is sparse but is still a legitimate definition. It is initially poorly structured since the use of the word 'and' between 'manufacture 'and 'sell' means that there are in fact two transformation processes.
Thus, logic would require the resultant model to contain activities to do with both manufacturing *and* selling. The transformation process identified within CATWOE, i.e., 'manufacture for sale', only leads to manufacturing activities.
The actors are specified as 'Production Department and Marketing personnel'. This may well be a reasonable choice of actors, but they do not appear in the RD. The RD would have to read:

A system, operated by Production Department and Marketing personnel, to …

The customer is also not specified within the RD although 'the market' appears within CATWOE. These errors arise because the student was still thinking about the real world to which the RD was seen to be relevant, rather than concentrating on the intellectual process itself.
The existence of two transformation processes makes the specification of customers difficult. The recipient of the output from 'manufacture' could well be the Sales Department whereas the recipient of the output from 'sell' would be an actual customer (within the market).
Although 'profit' is stated as a requirement within the RD it is not an externally imposed constraint. 'Minimum cost', however, is. The controller of the system can decide how much profit to make but cost *must* be minimal.
The fact that Owner is not specified within the RD illustrates the proper use of this CATWOE element. The student could now have decided whether it would be useful to include an 'Owner' and who the 'Owner' might usefully be. The iteration may have been done and the decision still reached to omit any reference to the wider system. Initiating iteration via the RD is what the CATWOE test is for, but it must be used properly. Whatever the decisions are, which are arrived at during an iteration, there should be a consistent pairing of CATWOE and RD.
The inclusion of MD as W, within CATWOE, is a common fault. Probably because of the 'profit' outcome the student had related the RD to the Managing Director. The implication of W within CATWOE is a means of extracting the belief contained in words in the RD not of attributing that belief to an individual. W is a statement of *what the belief is* not of *whose belief it is*.
Any individual will probably subscribe to a number of beliefs. Any attribution to an individual will, in any case, be coloured by the range of Ws and degrees of commitment to them held by the analyst doing the attribution. In relation to this sparse RD the statement of belief is simply: 'Manufacturing and selling a range of products at minimum cost *will* make a profit'. Within this rather sparse RD the belief is merely a restatement of the whole of the words in the RD. In a richer and more complex RD this would not be the case.

Example 2 Related to patient care

RD A hospital-owned system to comfort patients by undertaking regular visits within specified hours.

C patients
A relatives
T provide comfort
W visiting patients is a good thing to do
O hospital
E visting time

One of the problems with this RD and CATWOE analysis is that different words have been used to describe the CATWOE elements than were used I the RD and there is also considerable ambiguity in the definition. In some cases, the differences in the words may be regarded as trivial but as a general rule (given possible semantic problems), the same words should be used.
Thus 'visiting time' may be taken to be the same as 'specified hours' but it may not be, dependent upon who does the specifying. It may not even be a constraint if the system 'decision taker' is the one to do the specifying. The wording of the RD should remove the ambiguity and make this clear. The 'Owner' is 'Hospital' (or someone within the Hospital management structure). This is legitimate in terms of the CATWOE analysis but is it a relevant 'owner'? The wider system (given this 'owner') is apparently within the Hospital management processes and therefore, for the hierarchy to be coherent, we would expect the system also to be within these management processes. This raises the question as to who 'undertakes the regular visits'. The impression that this wording creates (particularly as A appears as relatives), is that the visitor is external to the hospital. However, this is not necessarily the case; it could be an internal visitor. Again, this is ambiguity that should be removed.
In relation to the 'transformation process', 'to provide comfort' is not the same as 'to comfort'. One can *provide* by ensuring that someone else does the comforting.
A is specified as 'relatives' but this word does not appear in the RD. Finally, the W in this RD (i.e., the belief) is that patients *will be* comforted through regular visits. The W specified in CATWOE is a value judgement about the acceptability of the purpose as a real-world activity. This is totally irrelevant as a technical requirement on the structure of a RD.
As a professional exercise I could produce a totally defensible RD (in terms of its structure) of a *system to cause unease within a community by random bombing*. To do this I would not have to believe that this is a good thing to do. The belief that would be contained within the RD is that random bombing *will* cause unease. Whether it is actually a good or bad thing to do is irrelevant to the structure of the RD.

Example 3 Related to service provision

RD A consultancy company-owned system, operated by skilled professionals, to satisfy clients' needs for technical advice by undertaking regular training and exploiting developments in new technology

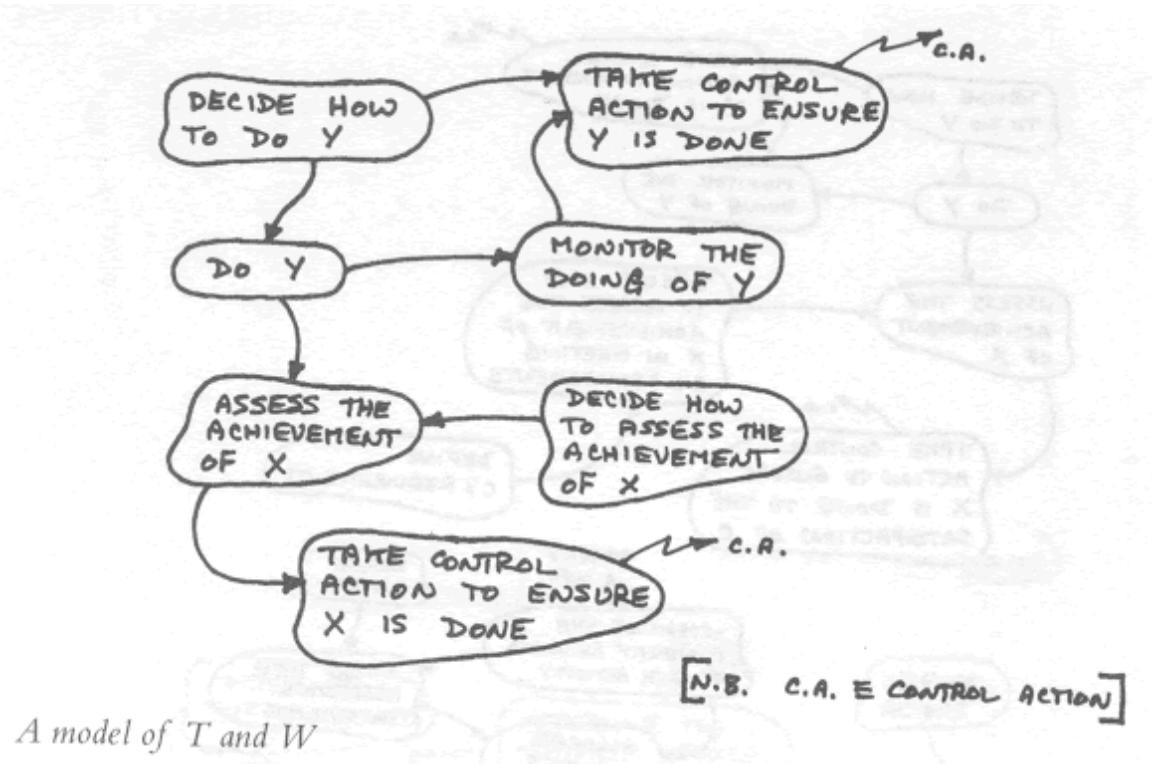
C clients
A skilled professionals
T to satisfy clients need for technical advice
W keeping up to date with skills and the technology is necessary to provide advice
O consultancy company
E none specified

The only problem with this RD and CATWOE is that the W (and hence the RD) contains an inconsistency. The actual W contained in the RD is that: 'undertaking regular training and exploiting developments in new technology (Y) *will* satisfy clients needs for technical advice' (X). It would be possible to undertake training and exploit new technology without having any clients or without knowing what their needs were. Clearly, doing Y is insufficient to achieve X.

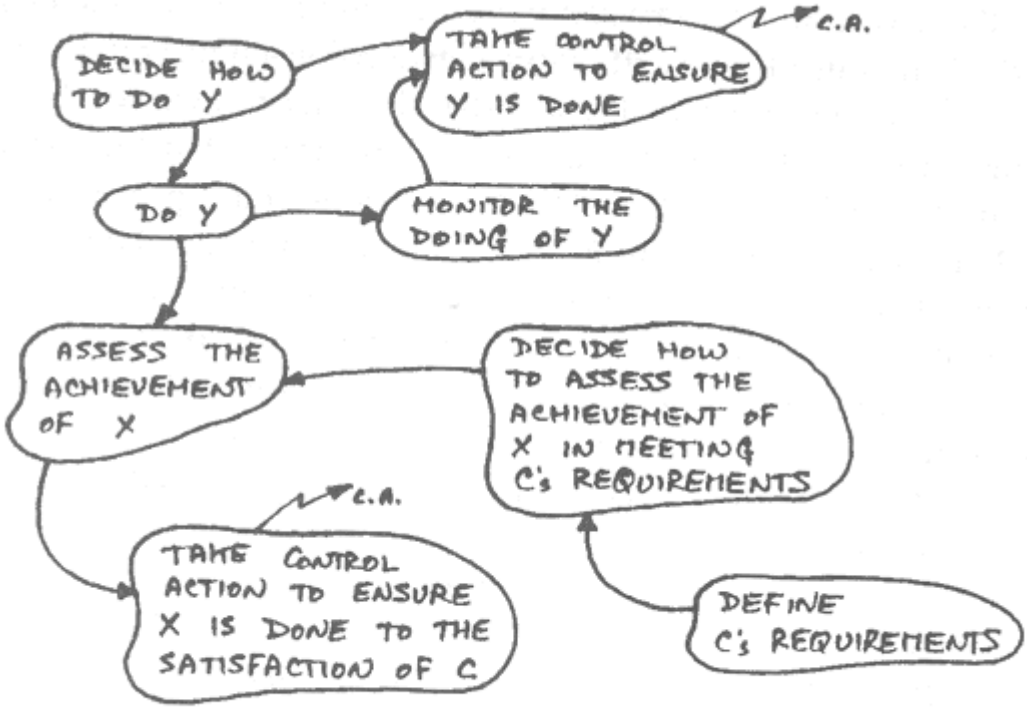
The W expressed in CATWOE sounds fine as a condition, but it is not the W expressed in the words of RD.
A more blatant and obvious example of this same fault appeared in a RD relevant to a manufacturing company. It was stated that the system was: '*To increase company profit by planning to diversify the product range*'.
The outcome of planning is a plan. This will have no effect on profit unless something is done with the plan.
The problems illustrated by these examples can be overcome by less casual use of the CATWOE test and critical evaluation of what it reveals about the words chosen in the RD. Adherence to a set of general principles and rules will also help.

In the third step, the root definitions are translated in **Human Activity Systems** (HAS). Those are in fact **conceptual models** of the original idea. They develop the root definition further in elements and interactions and make drawings of those. Conceptual models "expand" the root definitions. The elements of the conceptual models are either "verbs" or "arrows". Those conceptual models can be more easily communicated to outsiders.

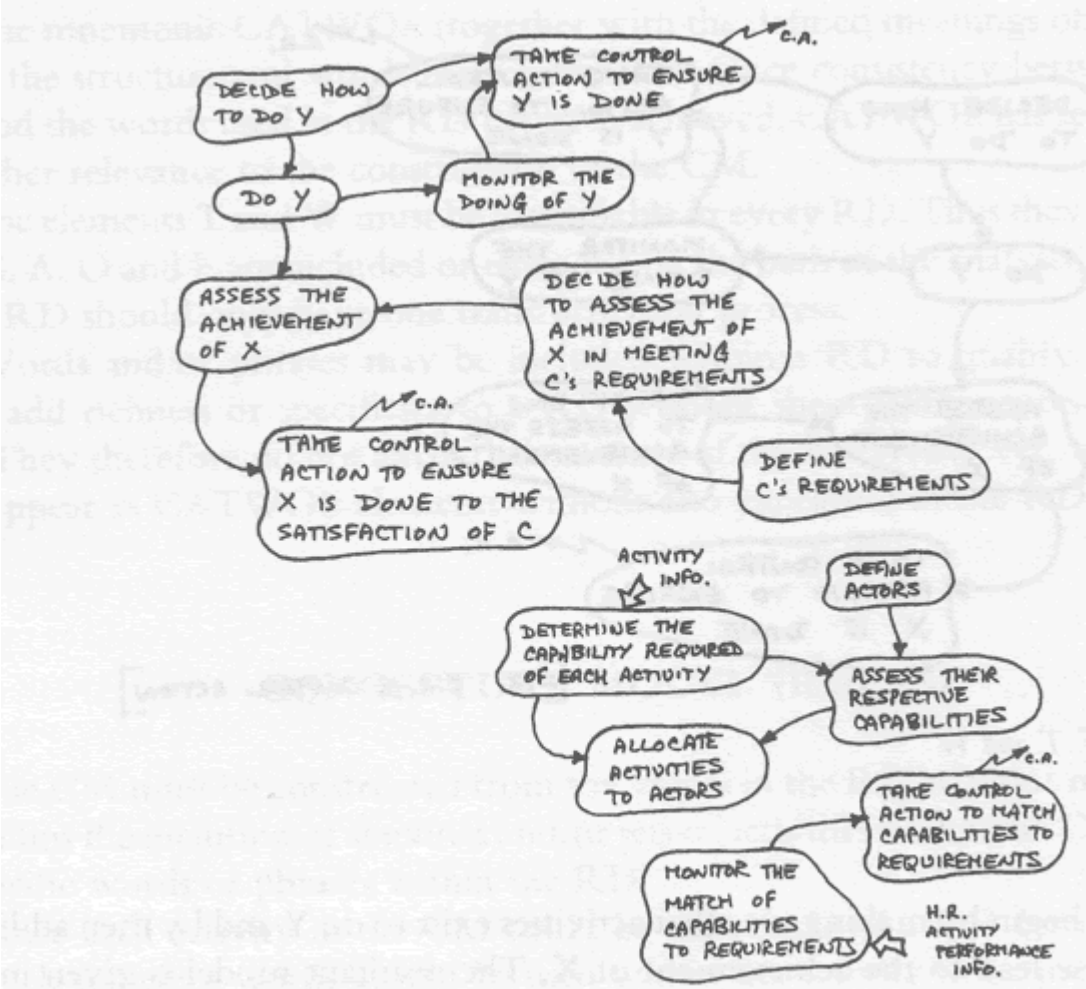
Verbs indicate actions that humans have to undertake in order to realize the root definition. Those verbs are stated in the imperative. **Arrows** combine those verbs. Those arrows can give performance information from each of the operational activities or indicate control actions from the activity.
Examples 3: Conceptual models



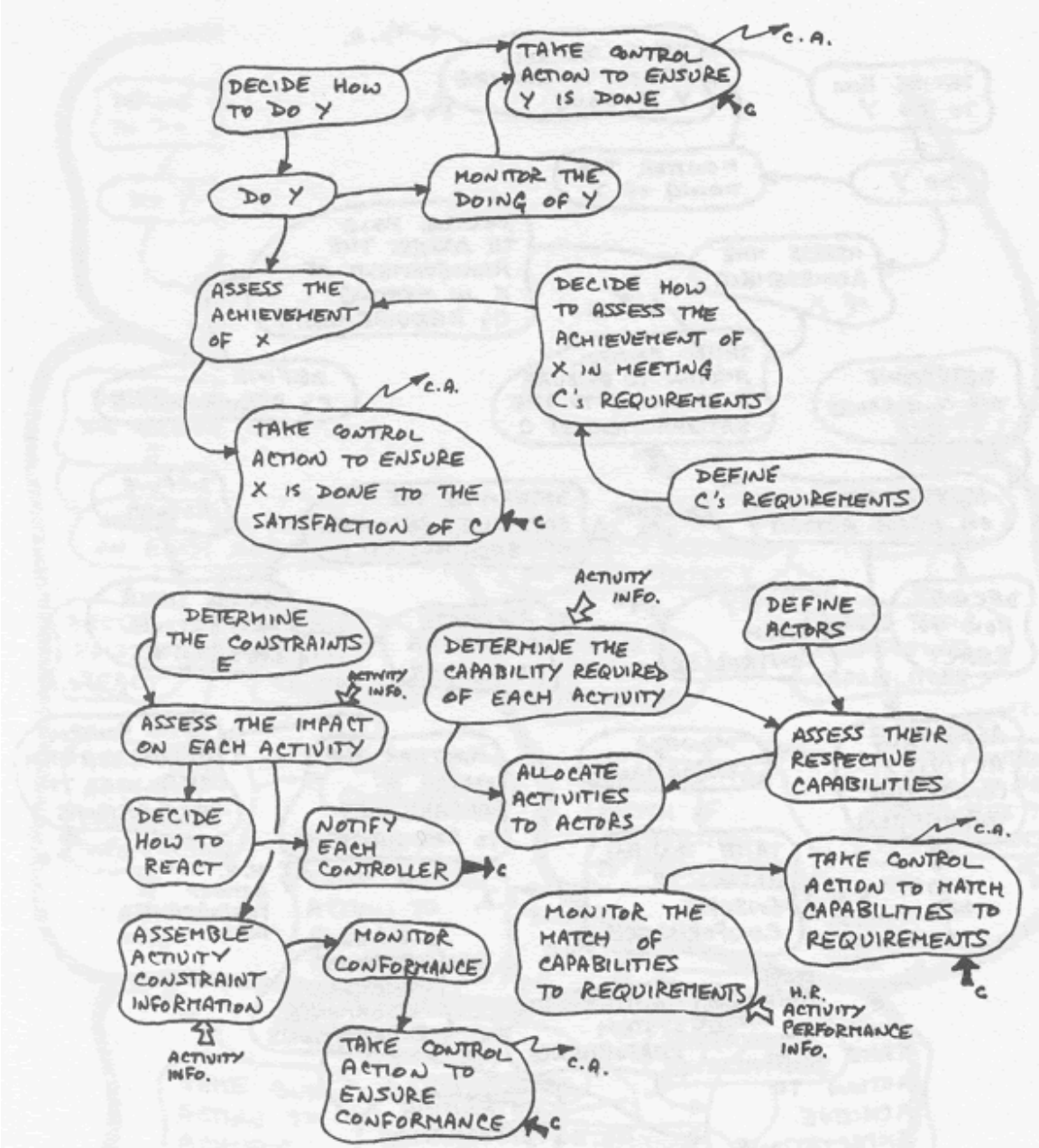
A model of T and W



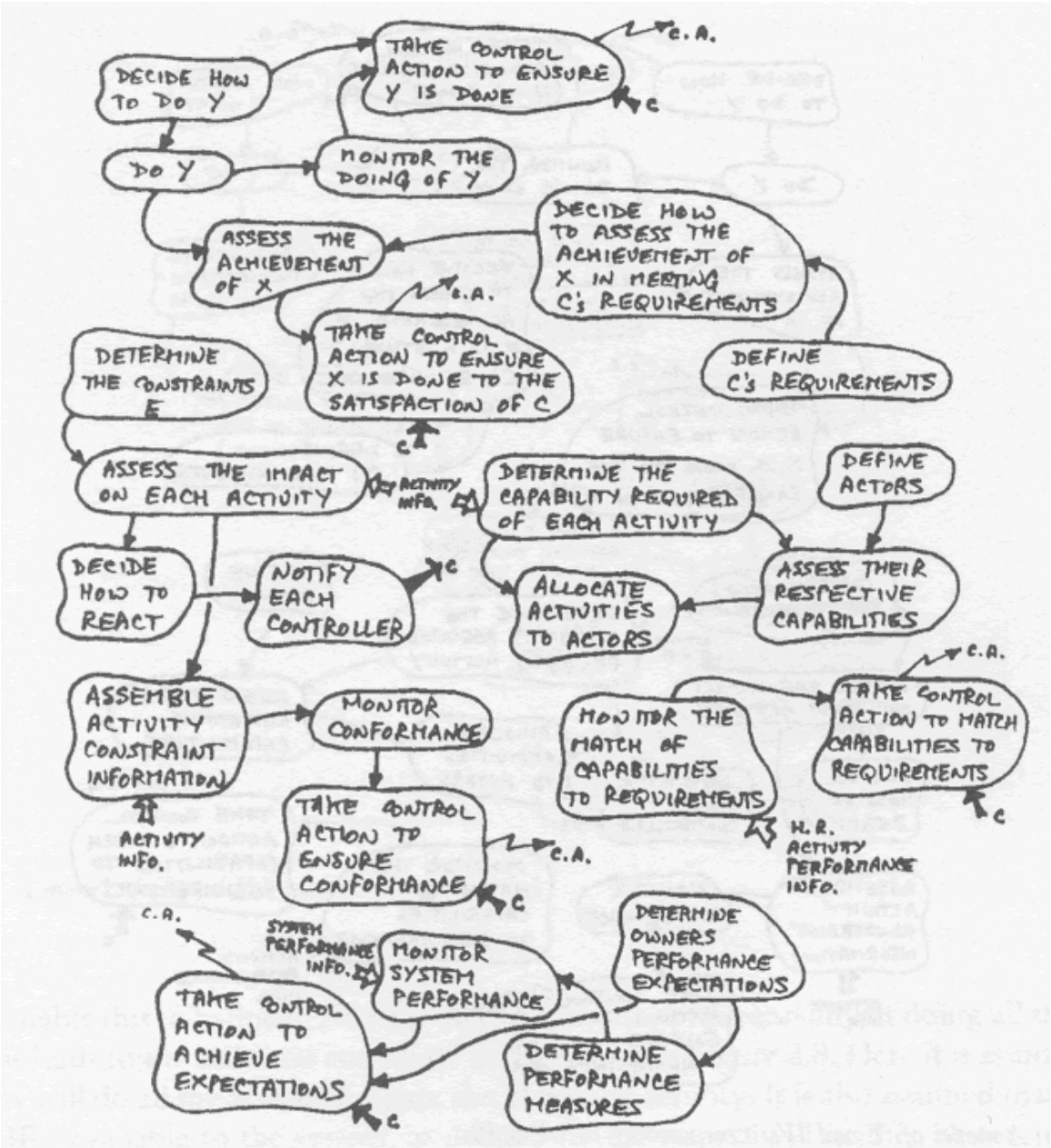
A model of T and W, incorporating C



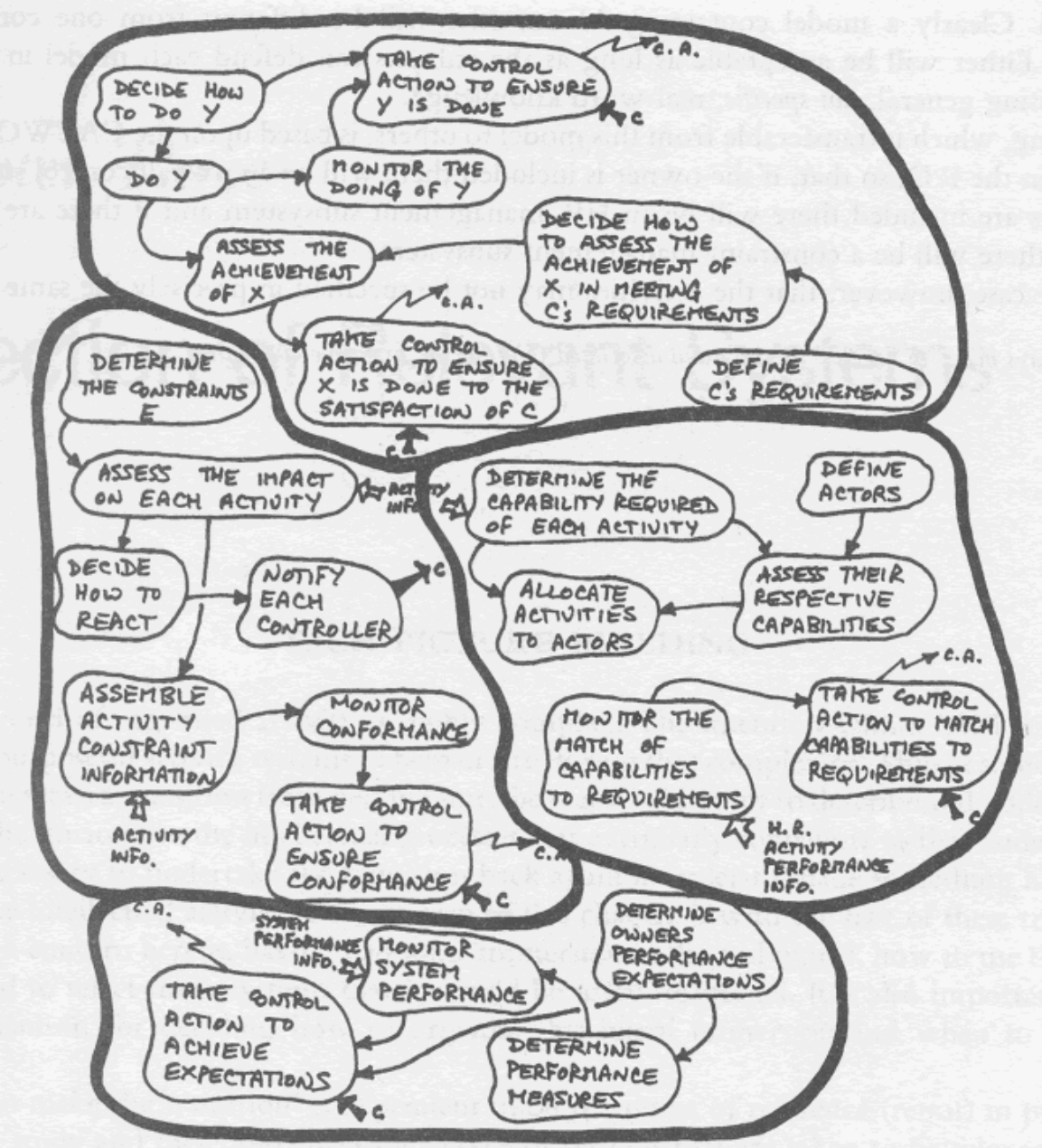
A model of T and W, incorporating C and A



A model of T and W, incorporating C, A and E



A model of T and W, incorporating C, A, E and O



A model of T and W, incorporating C, A, E and O decomposed into subsystems

The outcome of this phase is a kind of a drawing that has expanded the initial idea into a representation that pictures the mental model behind the idea, in such a way that it can easily be communicated and taken into the next step, i.e., check its innovative power.