Root definitions and conceptual models*

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Having completed stages 1 and 2 of SSM, the analyst should have a wealth of information on the 'real world' situation. How the analyst moves from the 'real world' to the world of 'systems thinking' is a subjective decision for the analyst but the following suggestions are culled from the literature and from experience.

Structure/process analysis

It is sometimes useful to try and make some sense of the 'real world' with a 'structure/process' analysis; that is to say, develop two ordered descriptions of the 'real world' situation which the analyst is seeking to understand, one identifying the elements of the system(s) under study and their relationships to each other, the other the processes in which the systems are involved.

The idea behind a structure/process analysis is similar to Heisenberg's 'Uncertainty Principle', that the more accurately you measure position, the less accurately you can measure movement and vice versa. A structure/process analysis tries to meet this limitation by giving some indication, at least approximately, of where the system is at a given point in time and of the directions in which it might move.

Relevant systems

The choice of 'relevant system' is completely up to the analyst. This reflects the idea that, however we may use the word 'system' in ordinary language, 'systems' are not 'real world' objects but the analyst's representations of the 'real world'. Whether a 'system' is 'relevant' is determined by the analyst's 'subjective' ideas about it. As Prigogine and Stengers (1984) say:

> All description thus implies a choice of the measurement device ... We have to describe which measurement we are going to perform and which question our experiments will ask the system. Thus there is an irreducible multiplicity of representations for a system ...

The results of this choice will be reflected in the outcome of stage 5, the comparison stage.

From the above, it should be clear that choosing the 'correct' system is impossible. It is only possible to choose a system which appears relevant and return to identifying a more relevant one if the stage 5 comparison reveals that the original choice was not sufficient for the current analysis. Spending time 'getting the choice right' is normally less helpful than proceeding with the analysis and repeating this stage, if necessary, after the comparison at stage 5.

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However two pointers may be useful. Try and think of 'relevant systems' with very different value bases for the same event. For example, the Miss World contest might be seen as:

- a system to make money
- a system to provide entertainment
- a system to promote international competition in non-destructive ways

Developing any one of these 'relevant systems' will throw up the very different values that underlie people's perceptions of the event.

Which set of values is relevant to the analysis will depend on the analyst and the purpose of the analysis.

Try and make sure that every 'relevant system' has an emotional kick. 'Human activity systems' are never value free and a bland 'relevant system' probably means the analyst has missed something.

The CATWOE analysis

Checkland uses this mnemonic to test for completeness in the development of 'root definitions' of 'relevant systems'. It stands for:

Customers
Actors
Transformation
W*eltanschauung*
Owner
Environmental contraints

However, the order is misleading since, in practice, it is usually better to start with the transformation and the *Weltanschauung* and follow these with the customers, actors, owner and environment. It is also worthwhile developing transformations and *Weltanschauungen* for several 'relevant systems' before deciding which one to develop. This can itself be a revealing exercise.

Transformation

The simplest transformation is covered by "a system to do 'x' " where the system 'S' takes input 'i' and produces output 'x'; however, many relevant systems take the form "a system to do 'x' by 'y' ". The Miss World contest, for example, might be better described as 'a system to make money by exploiting women.' ('A system to make money' is, in practice, too bland; it might apply to a business or a lottery.)

Inputs, outputs and measures of performance

To help people think about the transformation, Checkland suggests that they define the inputs, the outputs and the measures of performance they might apply to that transformation. For example, the inputs of a social services department intake system might be interviewers and enquirers, the outputs might be various types of paperwork and the measures of performance the time taken to deal with each enquirer, how soon the paperwork was completed and how

satisfied the enquirers were. The transformation might be 'from private problem to public record'.

Weltanschauung

The usual translation of *Weltanschauung* is 'worldview' but the German word has become part of systems jargon so I have retained it here. Identifying the *Weltanschauung* implied by the transformation is the key to soft systems approaches. Rather than trying to remove bias from the analysis, all soft systems approaches make it an explicit part of the analysis.

This can be uncomfortable for the analyst in two ways. Firstly, the analyst has to confront his/her own biases and secondly, the identification of biases in the organisation may be culturally unacceptable. How the analyst comes to terms with these issues is dealt with elsewhere (see note on 'Appreciative systems').

Customers

The customers of a system are those who benefit from the system; 'customers' should never be confused with 'clients'. Many systems which ostensibly serve one group in practice benefit quite a different group — these are the 'customers' in SSM. Occasionally, the system may affect people adversely — the term 'customers' is still retained even though the benefits are negative ones.

Actors

Actors are those who make the system work. Sometimes they may be the beneficiaries of the system or even the owner of the system; usually they are not. Even though they make the system work, they do not have the power to disband it; if they stop working, others can take their place.

Owner

The owner of the system is the person or group of people who can bring the system to an end. The owner may not be a beneficiary or an actor in the system — s/he may not even know that an analysis of the system is being undertaken — but s/he will determine whether the system survives. For example, many people could analyse the Social Fund without the Government knowing it or try to undermine it but only the Government can dismantle it.

Environmental constraints

Every system exists in an environment. The 'root definition' should include anything special in the environment of the system which is likely to affect the transformation being undertaken by the system. It is often difficult to determine where to stop because all systems work under environmental constraints but there are usually some constraints which common sense suggests would affect every system in this environment. These should be omitted and only those relevant to the particular transformation included in the 'root definition'.

Creating a 'root definition'

I would generally develop at least three 'relevant systems' as far as transformation and *Weltanschauung* before selecting the one on which to develop a complete 'root definition'. Though the form of a 'root definition' may be variable, the general form is:

> A system owned by 'o' in which actors 'a' perform transformation 't' for the benefit of customers 'c' within the Weltanschauung 'W' and the environmental contraints 'e'.

Most 'root definitions' are much longer than this, particularly if the transformation is of the form "a system to do 'x' by 'y' ".

Building a conceptual model

Once a root definition is complete a conceptual model can be built. The elements in this model will be 'activities' and it is therefore worth looking for verbs in the root definition. Sometimes the 'activities' in the conceptual model can be linked to produce English-like sentences.

To illustrate the process I have created a root definition for an intake system in a social services department:

> A department owned system in which staff interview clients to record their problems in such a way that whatever staff, generic or specialist, are required can deal with them and so discharge the department's responsibilities within the constraints of time and the competence of the intake staff.

The CATWOE analysis of this RD would be:

Customers	departmental staff
Actors	intake team, clients
Transformation	from private problem to public record
W*eltanschauung*	good recording ensures the department can discharge its responsibilities
Owners	department
Environmental constraints	time, staff competence

Note that in this system, the customers are the staff of the department who 'benefit' from having good records.

The 'obvious' verbs are:

- interview
- record
- deal with
- discharge

We will probably need to add:

- note (arrival of client)

since the first is necessary for the interview to start. I have decided to split 'deal with' into

- decide (disposal of record), and
- pass on (to appropriate staff)

I have decided that 'discharge' is related to the system as a whole and not an activity within it.

The test for each element is that there is logical dependence between elements; for example, to begin an interview, one must know the client has arrived. In this case I have not considered what happens before a client arrives, e.g. who decides who is on duty, because I have chosen a relevant system which takes this for granted. However, had I been studying the allocation of duty in an area office, I would have adopted a very different relevant system and then created a very different root definition.

Equally, I have not concerned myself with what happened to the client before his/her arrival since, even though it may form the content of the interview, I have decided it is not relevant to the system I am studying.

From this we can create a conceptual model containing the five activities: note (arrival), interview, record, decide (disposal), pass on (record) (Figure 1). Checkland suggests that 'seven plus or minus two' is good rule of thumb for the number of activities in a conceptual model. If there are many more, he would suggest you can confusing detail with the main framework. This may be a cue to return to your root definition and try and refine it. If the project you are engaged in is very large, you may need to develop a broad root definition containing, say, seven key activities and then go back round to cycle, developing seven more root definitions, one for each element in the broad root definition, i.e. develop a root definition for a system and then root definitions for each of its subsystems.

Measures of effectiveness

Having decided on the outline of the conceptual model, it is important to decide how it is to receive feedback on its performance since, without feedback, it will go on for ever. Three questions need to be answered:

- is the system doing what it is supposed to?
- is the system doing it *well*?
- is this the best way to do this?

Checkland refers to these as effectiveness, efficiency and efficacy. However, I prefer to remember them by the questions. I have indicated on figure 1 one way of interpreting these three questions. The questions are asked of the whole system and the results of the answers should be fed back into the system to enable it to monitor and control its own performance.

Note that these are different from the ideas in Inputs, outputs and measures of performance, since I have developed my ideas about this system in the course of writing about it.

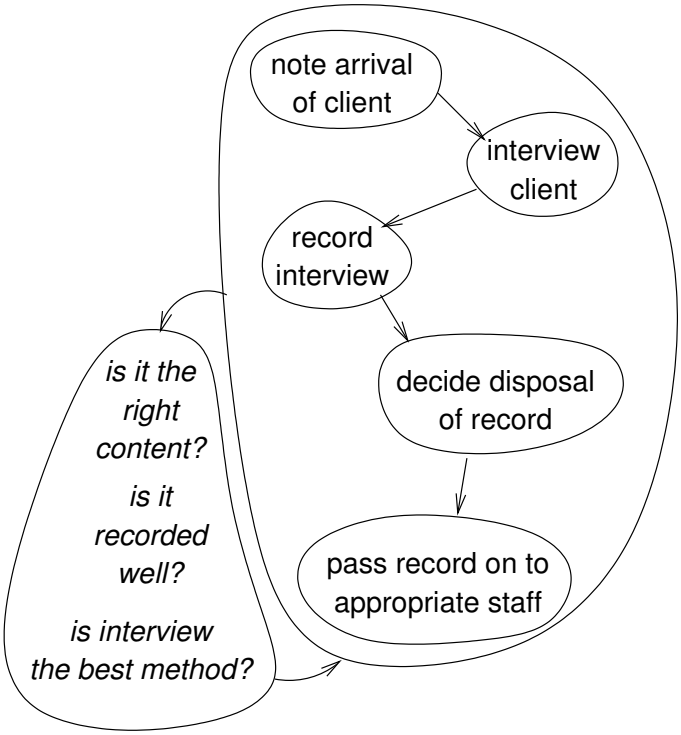

Figure 1: Conceptual model for an intake system

The Formal Systems Model

To enable the analyst to check that the conceptual model is 'systemic' Checkland provides a definition of a system. A system is a system IF and ONLY IF:

1. it has an ongoing purpose or mission
2. it has a measure of performance
3. it contains a decision taking process
4. it has elements which are themselves systems
5. it has elements which interact
6. it has a wider system within which it interacts
7. it has a boundary (separating it from its wider system/ environment)
8. it has resources at its disposal
9. it has some guarantee of continuity (1981, pp. 173–174).

Conclusion

I have tried to indicate in outline the key features of 'systems thinking' in 'soft systems methodology' (SSM). Some of these are derived from Checkland (1981), some come from the OU course

T301 ‘Complexity, management and change: applying a systems approach’, some come from more recent work by Checkland and his colleagues and some come from my own experience.

Soft systems thinking is still at an early stage in its development compared with hard systems thinking and the opportunities to contribute to its development are open to anyone interested in applying soft systems ideas to human organisations.

References

Checkland, P. (1981). *Systems thinking, systems practice.* Chichester: Wiley.

Prigogine, I. and I. Stengers (1984). *Order out of chaos: man's new dialogue with nature.* London: Heinemann.