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The use of systems methodologies in natural resource development management

W E Hutchinson[1]

SUMMARY: Approaches to developments with environmental impacts are often said to be 'holistic' in nature, yet often do not use any systemic methodology to aid in the problem solution. This is especially true in the initial stage of scoping the problem. It is here that elements are included or excluded from the problem space: that is, where the context is set. This paper will, using the case of Integrated Catchment Management in Western Australia, examine the use of a systemic management tool – Critical Systems Heuristics – to provide a practical framework for managers in this area.

THE MAIN POINTS OF THIS PAPER ARE:

- Problems can be classified into types based on the complexity of the system elements (simple, or complex), and the human context (unitary, pluralist, or coercive).
- How an interventionist in a problem perceives its type will profoundly affect the solutions offered.
- The methodology chosen to solve a problem will have its own set of assumptions about the problem type, and the interventionist must reflect on these...
- Many technical 'experts' in the area of water management tend to assume problems are of the simple-unitary type.
- Most natural resource/environmental problems should be treated as complex-coercive.
- Determining the boundary of a natural resource/environmental problem is a very important stage in the solution process, yet often overlooked, or drawn up without much investigation of other viewpoints.

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1. TYPES OF PROBLEM

Assumptions about the nature of a problem can have a profound effect on the solutions offered for it. Environmental management problems are often contentious, as views about their nature, cause, and impact can vary enormously. In these circumstances, managers must be aware of their assumptions about the limits of the problem. The first stage for an investigator should be to define the problem. This definition is based on assumptions (either conscious or unconscious) about the type of problem being dealt with.

Problems can be classified in many ways. Flood and Jackson (1991) use two criteria to set the context for problem interventions: the 'people' situation, and the complexity of the system elements. They classify the people situation as unitary, pluralist, and coercive. **Unitary** describes a situation where those involved with the problem have the same opinion as to what the problem is (although they may disagree as to ends). A **pluralist** situation is one where those involved have different viewpoints and cannot agree on one perspective but are willing to mutual negotiations. A **coercive** situation is one where the human actors have no shared values, and are antagonistic – this implies a willingness for the protagonists to utilise power against the interests of others. The system elements are described as **simple**, when the components are predictable, and tend to be few with a small number of interactions. In this case simple problems can be complicated, but are not complex in system terms. **Complex** indicates that the system elements are problematic, numerous, and have a multitude of states and interactions. The classification is described in Table 1.

Thus, Flood and Jackson's classification includes problems from simple/unitary to complex/coercive. In practical terms, their main contribution to theory was the seemingly obvious point that different problem types require different methodologies to produce satisfactory solutions. Practitioners tend to use the same approaches all the time. Yet, underlying these approaches are assumptions about the problem type, which may not match with the real situation.

	Unitary	**Pluralist**	**Coercive**
Simple	S/U	S/P	S/C
Complex	C/U	C/P	C/C

Table 1: Types of problem.

Hutchinson (1998, 1996) takes this argument further, and states that it is not just a case of matching a methodology to a problem type, but investigators must be reflective on how they are going to treat the problem. What are **they** going to **assume** about the problem? In other words, problems do not have intrinsic properties. It is the problem interventionist who sets the context.

There is a great temptation with those with technical knowledge to assume a problem is of simple/unitary type. 'After all, we all know what the problem is, don't we?' This attitude tends to lead straight into the solution stage without ever stating the problem in an inclusive way.

In system terms, it is the boundary put around a problem, which sets the context. It is this that allows elements to be inside or outside the system. The distinction between treating a problem as a simple/unitary one, and regarding it as a complex issue for which there are many differing viewpoints, can be

[1]School of Management Information Systems, Edith Cowan University, Churchlands, Western Australia, 6024. Phone: (08) 9273 8283, Fax: (08) 9273 8332, email: w.hutchinson@cowan.edu.au

found in this boundary. Therefore, if the boundary definition only includes a narrow set of views, it will tend to be exclusive of many viewpoints. Midgely *et al* (1998) expand the concept of the boundary by introducing the concepts of **primary** and **secondary** boundaries. A narrow (primary) boundary outlined by one set of people, and a wider (secondary) boundary definition by another will create a group of **marginalised** system elements. It is the inclusion of these marginalised elements which is likely to be most contentious, and most prone to 'power play'. It is the marginalised elements, which are often ignored by management because of their difficulty, and by experts because they are regarded as irrelevant to the problem at hand.

This paper makes the assumption that including as many viewpoints as possible into the solution will provide a 'better' outcome. This view is not held by all. Many managers and experts consider that some viewpoints are not valid. In the case of managers, many feel that some viewpoints are detrimental to the perceived purpose of the organisation. In the case of experts, they may believe that some viewpoints are incorrect as matters of **fact**. Whilst this elitist style has some valid arguments, this author takes the view that those affected by the system should have some input into its design. This stance is based not only on the consideration of ethical aspects, but also on the effectiveness and efficiency of the system solution. It is also the author's prejudice to treat almost all natural resource / environmental problems as complex and coercive.

2. DEFINING THE BOUNDARY

Whilst **what** is to be included in the system (the scope) is critical, **who** will decide what is to be included is equally important. After all, it is the 'who' that will decide the 'what'. One methodology, designed to expose the system boundary in an inclusive way, is Ulrich's Critical Systems Heuristics (CSH).

CSH was developed by Ulrich (1993, 1988) to help identify the normative content of systems. The aim of CSH is to make the system developer aware of the oppressive and unequal conditions that occur in problem situations. Ulrich argues that determining the boundary of a system under investigation depends on the *"subjective interests, values and knowledge of those who judge..."* (Ulrich, 1993). The determination of the system boundary has a fundamental effect on the investigation. Ulrich developed a checklist of boundary questions, which would then aid in the identification of the context of the problem situation.

This boundary checklist contains four categories. It includes the system design's basis for:

- values,
- power,
- knowledge, and
- legitimisation.

CSH therefore attempts to expose the values underlying the problem situation. In addition to the values assumed in the situation, the perceived power influences are uncovered. The elements of power within the situation are not just the overt, but also the perceived power differentials. The elements of knowledge and legitimisation are also examined; these are entwined with the issues of power and values. These considerations go to the deep, underlying bases of the problem space by exposing assumptions often hidden in other methodologies.

From these four categories, Ulrich devised a series of 12 questions to expose the critical elements of the **existing** and **desired** components for the system being designed or investigated. Each question investigates what the existing situation **is**, and also, what it **ought to be**.

The twelve questions are (the author's comments are in brackets):

1. Who is/ought to be the **client** of the system design? (Who are the beneficiaries, or victims of the system?).
2. What are/ought to be **purposes** of the system design? (What is the system supposed to achieve?).
3. What is/ought to be the system's in-built **measure of success**? (This is associated with the previous point. How do we know the system is working?).
4. Who is/ought to be the **decision maker**? (Who determines what happens?).
5. What **components** of the system and what **conditions** of successful planning are/ought to be controlled by the decision maker? (What parts of the system can management control?).
6. What is/ought to be considered part of the system's **environment** that is, not under the control of the decision maker? (What is it that management cannot control?)
7. Who is/ought to be the **planner** of the system?
8. Who is/ought to be the **expert** in the design of the system? (Whose views will be taken seriously in the system design, or problem solution?).
9. Who is/should be the **guarantor** of the system? (Who has the power to ensure the system continues?).
10. Who are representing the **witnesses** of the system that is, who is/ought to be representing those not involved in the system design but affected by it? (Who will ensure that the people affected by the solution offered but have had no input to it, are protected?).
11. Are those affected by the system allowed to **emancipate** themselves from the experts? (Does the solution allow greater freedom of opportunity for those affected by the decisions of the powerful?).
12. What **worldview** underlies the system? Is this worldview shared by those involved and those affected? (What assumptions about the problem are made, and are they shared by those involved?).

These questions should bring out the sources of control, motivation, expertise and legitimisation of the existing system and also the desired system. The discrepancies of perceived power will also be illustrated. They examine issues, which are at the root of the problem and give perspectives from the various actors in the system being investigated. It is the use of these questions at the problem specification stage that this paper advocates. These questions are useful for determining **what** should be included in the system. They are invaluable for designing the system, and for exposing the existing problems.

However firstly, **who** decides the 'what' should be resolved. (This also begs the question who should

decide who is included). Ulrich feels that the system boundary should be set by those **involved** (clients, decision takers, designers) and **those affected but not involved** (witnesses).

3. USING CSH TO DEFINE A BOUNDARY – A CASE STUDY

Many environmental management problems are a complex mix of technical, ecological, social, political, and economic dilemmas. The case of integrated catchment management (ICM) in Western Australia (WA) is no exception. Despite its relatively low population density, it has a number of major environmental problems such as salinisation, species extinction, introduced species, and soil erosion. The gradual degradation of the water supply (almost all the rivers in the southwest are brackish) is also of significant economic interest.

The Office of Catchment Management was set up to develop community involvement in catchment coordinating groups. Initially successful, the responsible department gradually lost status and influence, and has now disappeared. Catchment groups still exist but are fragmented. A project was initiated to design an effective organisational structure and system.

It was decided to interview those who were to have input into the study on an individual basis. The reason was that the situation was considered political in nature, and whilst group meetings could have given different results, single interviews would divulge more honest viewpoints.

The problem space needed a boundary drawn before any design work could take place. The first task was to choose the participants who would determine the boundary. It is at this point that the system interventionist needed to be reflective. There is a great danger of only including those who match the interventionist's narrow view of the problem. Taking into account CSH's need to include those involved with the system as well as witnesses (see above), the choice of those who were to have input to the study was made using the following criteria:

- **interest** in ICM at the management, policy, theoretical, and implementation levels,
- **involvement** with ICM. - including those that were involved with the existing catchment coordinating group system and those who were not, and
- the **assumed philosophy** of the person, that is ranging from deep ecology ecocentric to technocentric(this was based on O'Riordan's [1989] definition of the continuum of various beliefs regarding environmental issues) .

According to White (1973), those who take part in water decisions primarily come from planners, administrative / political officers and individuals affected. However, this investigation expanded this subset to include very important parts of the population with real interests in ICM such as, community/pressure groups, and landowners. The omission of these groups would have resulted in a very narrow, technical approach to a problem which was considered complex and coercive.

Those that were 'interested' in ICM were chosen using the following criteria:

- **Managerial and policy making interest**: these included officers of government agencies (local and state), and politicians (local and state).
- **Academic interest**: these included academics from various disciplines, for example, environmental science/law, ecology, economics, philosophy, engineering, and psychology.
- **Implementors of ICM**: these included officers from state and local government, Catchment Coordinating Group members, and farmers.
- **Interested Group members**: these came from farming, business, and industry groups, federal agencies, conservation groups, and the public.

Finally, the above groups covered representatives with assumed philosophical stances ranging from the extremes of ecocentric to the extremes of technocentric thought. Although, it was difficult to implement this final criterion as opinions are not finite or static, and often cannot be determined until after the data are collected. After the sample was determined, the questions to be asked were devised from the twelve from CSH plus one on the environmental philosophy of the interviewee. Another question concerned with their opinion of what would constitute good measures of success for the system (in terms on efficiency, effectiveness, efficacy, and ethicality of the system) was added. This latter question was to supplement the data on the required outputs of the system.

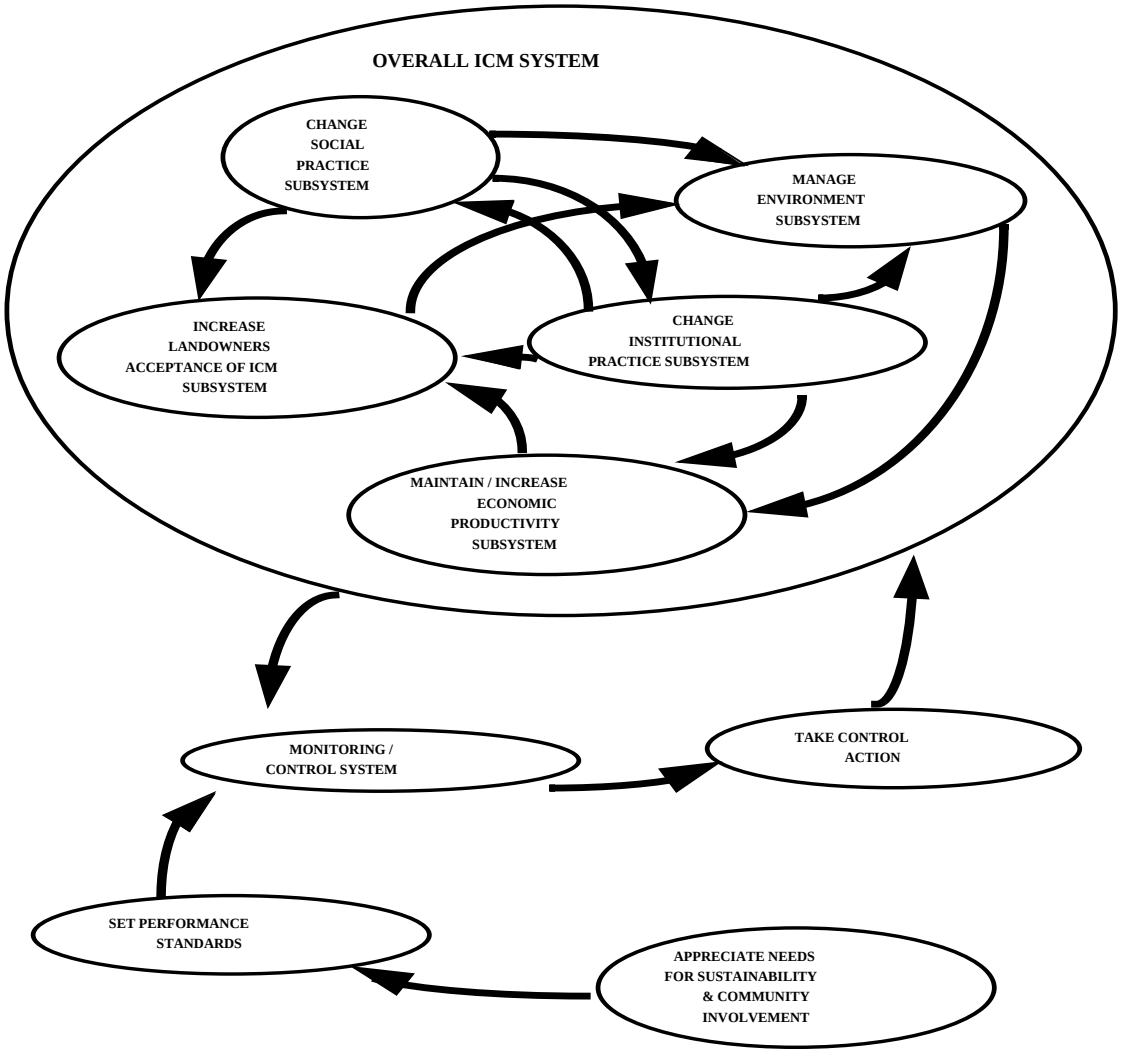

Figure 1: An upper level conceptual model of the tasks needed to be executed to effectively run an ICM system (Hutchinson, 1996).

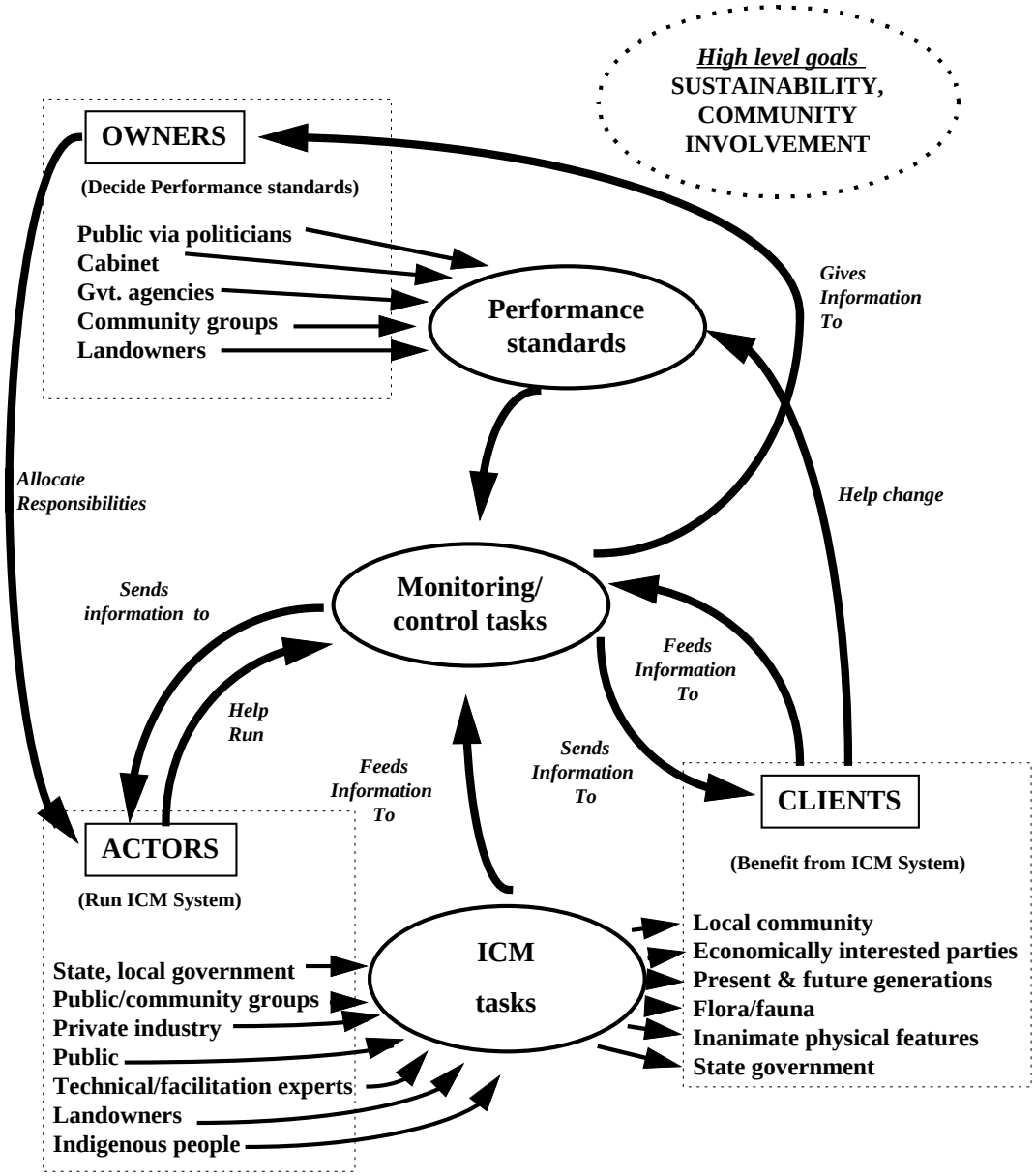

Figure 2: An illustration to show overall desired ICM system in terms of the needed participants, and their relation to the tasks needed to execute the system (Hutchinson, 1996)

For an issue which concerns the whole of the state of Western Australia, the sample was relatively small (40 people). However, the data obtained from this selected group was large. It provided enough material to develop inclusive task and organisational models. Figure 1 shows a conceptual model of the fundamental tasks needed to be executed by the ICM system. Figure 2 shows a model developed to illustrate those groups participants who were perceived to be a part of the problem, and the broad-based functions they perform. These models could then be used as discussion points for further public and government discussion. The alternative (and normal procedure) was for the government agency to develop a plan for public discussion. Thus the agenda would have already been set by the agency. This gives an illusion of true public involvement in the problem definition. The public could only criticise a *fait accompli*, as the boundary would have been set and the problem defined. Therefore, only details of the solution could be changed within a predefined framework.¿

Whilst the CSH process, listed above, is not perfect, it does include a variety of opinions about what is to be included in the problem definition. Also, the models produced are a focus of learning for all the participants involved with providing a solution. As the limits of the problem are expanded so does their knowledge of it. It provides a coherent and effective method for setting the context for a contentious situation. More mechanistic methods can be used within this framework.

4. CONCLUSION

This paper has concentrated on large natural resource / environmental problems at the preliminary stage of investigation. The technique illustrated above (CSH) was used in an 'elitist' way to determine the problem boundary by using specific questions to build a picture of the required system from a group of people with disparate worldviews. The assumption is that the more inclusive the problem definition then the more robust will be the solution.

The context of contemporary water and river management inevitably involves public participation, and probably some contestable issues. However, just including the public does not necessarily mean there is a meaningful dialogue. This paper has attempted to show an approach, which enables management to set a richer context for greater social discussion. It is an illusion to claim general participation when it is an interest group, which sets the ground rules for the problem.

It is the responsibility of the problem interventionist to ensure any system definition is an inclusive one. The use of CSH can aid in the process of determining who will contribute, and what should be included. It is only by using principles such as these that effective, efficient, ethical, and professional systems will be developed. The definition of problem boundary determines its solution.

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