Understanding Complex Adaptive Systems for AWRM: A Social Simulation & Workshop

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This document describes a process for introducing Complex Adaptive Systems theory to water managers in order to make links for practice in AWRM (Adaptive Water Resource Management). The process described comprises background thinking and facilitator instructions and materials for a social simulation and workshop.

The Target Group

The target group includes:

- Engineers and managers involved in planning, implementation or operation of river basin projects in one or more of the following disciplines: irrigation, drainage, hydro-power, flood control, soil & water conservation.
- Managers who have operational knowledge and project management experience (and possibly previous training) in the implementation of WFD/IWRM at the river basin level.
- Preferably MSc level education or minimum undergraduate level in a specialist subject.

Taking part in this social simulation and workshop will lead to:

• A better understanding of phenomena arising in day to day work (e.g. “I planned this task to its utmost detail, but it went wrong anyhow” etc.)
• Learning that complexity is the rule and not the exception in contexts of uncertainty and human-technology-environment systems (e.g. “Why are we changing our strategy again? We changed already a year ago! These guys up there really do not know what they want…”)
• Finding ways, means and potential strategies to cope with uncertainty (e.g. “Ok, if this is Complexity, then what does it give me? How can I apply it?”).

It is very important that the goal and intention of this social simulation and workshop is properly communicated to the target group. In this way it will enable the participants to make sense about the simulation, the workshop, and its purpose. The first communication with the target group might be decisive for the overall success of acceptance and adoption. Therefore, delivery should take into account that it will address people who have very limited time frames to be introduced to something new.

Goals of the Social Simulation and Workshop

The goal of the social simulation and workshop is to provide a basic introduction to the target group of participants who need to receive an update on IWRM and learn about the conceptual foundations of AWRM and complex adaptive systems

theory. It is not the intention to explain all theories and their roots in detail, but to allow them to understand the basics (e.g. you do not need to know how cars are built, in order to drive them). Therefore, it will be necessary to provide participant swith input, so that they can:

• Consider a different POINT OF VIEW,
• Make sense of this in the context of REFERENCES/EXAMPLES,
• consciously EXPERIENCE complexity,
• RECOGNIZE, OBSERVE and IDENTIFY complex phenomena and relate it to AWRM and practice

Content of the Social Simulation & Workshop

The intention of this approach is to lead the participants through an apprenticeship based on action – experience (first experience, and then concepts to describe the experience, see “science praxis” - Agyris). It is commonly accepted, that learning is most effective when it is linked to practice. However, learning a new perspective and reflecting one’s day to day practice through this perspective takes time. The decision for the application of the social simulation and workshop must therefore consider the impact of time (psychology of learning) on the overall process and in order to gain most benefit, should be delivered in conjunction with the dissemination of the GWP Handbook Supplement, ‘Keeping Change Going’. The supplement should be read prior to participants attending the workshop session in order to be able to fully take part.

The main aspect of the social simulation described here is an exercise, an exercise based on action. The exercise is intended to confront people with a new perspective that leads them to change their point of view, by getting them out of their routine thinking. It is very important to let participants experience the exercise and not only see them happen.

After the exercise it is important to reflect what happened during the exercise (provide feedback). The facilitator has then to “elicit” the participant’s emotions and feelings. Understanding complexity and dealing with it can best be observed through the expression of fears of the participants. From psychology it is known that individuals do not feel comfortable in chaotic/uncertain situations and always try to achieve a certain amount of stability and put structure in their observations, even if participants often say they do not (see Watzlavick 1973). Fear, feelings and intuition are important indicators to be addressed when trying to bring people to understand complex situations.

After the exercise and the feed-back, some general input about complex adaptive systems and the 6 complexity principles should be given to the participants. The facilitator has to establish a clear link to the concrete experiences made and feed-back obtained during the exercise. Further links should be established to the individuals’ daily experiences within stakeholders, organisations etc. This

work gives the possibility to the facilitator to adapt his/her input to the concrete and specific needs of the participants.

The social simulation and workshop at its very heart aims at sensitising participants to an understanding and experience of complex adaptive systems and key properties of them.

The social simulation and workshop allows those taking part to “experience” complexity, uncertainty and to learn how to express it and make sense of it in relation to AWRM. By the means of different specified roles people start acting according to the one they are given. The consequence is that along the duration of the exercise the participants experience 6 properties of complex adaptive systems.

The experiences are then reflected with the help of a facilitator who is guided by a clear set of questions.

The Social Simulation & Workshop

This section introduces and explains the social simulation and workshop to be facilitated in conjunction with the delivery of the GWP Supplement, ‘Keeping Change Going’.

In the context of this social simulation and workshop, a 3-4 hour time period is required – preferably as a half day session.

Usually workshops start by presenting some initial theoretical content and afterwards provide some exercises. However, in a series of cases it has proven to be more effective to first let people experience a certain situation and then reflect on it theoretically under the advice of an expert. This usually creates a high impact “aha”- effect. The aim of the workshop is to lead the participants through an apprenticeship based on action – experience. It is commonly accepted, that learning is most effective when it is linked to practice.

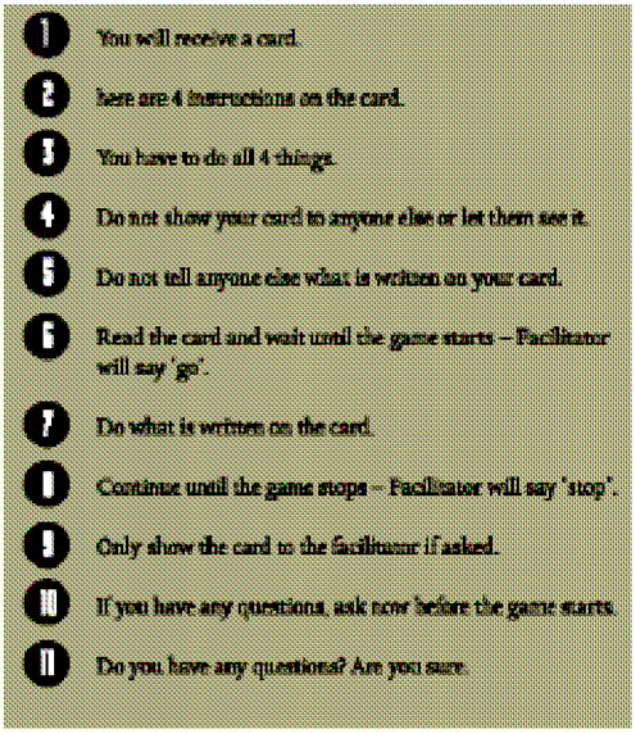
The objective of this workshop is to provide another way of looking at river basin management through the lens provided by complex adaptive systems theory as a stepping stone to adaptive water resource management (AWRM); help participants understand the basic meaning and implications of self-organisation, emergence, the edge of chaos, diversity, unpredictability, historicity/time, and pattern recognition.

Four participants or more are required, and the maximum number of players is 25. The following agenda may be useful:

- Welcome & Introduction – 5-10 mins
- Social Simulation – max. 40 mins

- Coffee Break – 10 mins
- Discussion on Complex Adaptive Systems Theory & Properties – 65 mins max
- Coffee Break – 10 mins
- CAS Theory & AWRM Practice – Small Group Session – 35 mins max
- Coffee Break – 10 mins
- Implications & Drawing Conclusions – Group Discussion – 20 mins
- End of Workshop

The following instructions are given to participants:



Then, each person is given a card from a pack of 25 playing cards (to be kept in order and given out to players in order) with the instructions written on them (see appendix 1 for a copy of the content of these).

Facilitator Instructions:

Give the instructions to the group – make sure they understand they are not allowed to tell/show others (except you) what is written on the cards. Then give the cards out (one per person) in the order of the pack – put any remaining cards back in the pack. Wait until everyone looks as though they have read and understood the card, and say 'go'.

During the exercise, don't do anything to interfere intentionally – but if you somehow get involved, tough luck! Tell the group to 'stop' after about 20 minutes

or half an hour. Break for coffee and a calm down! (If the exercise has come to a natural end, stop for coffee and a break sooner).

Debrief Instructions:

1. Keep things light-hearted!
2. Ask them what the experience was like – allow them to ask each other questions and to make their own comments about what went on.
3. Point out that all the things that did or did not happen could be talked about in terms of the properties of complex adaptive systems theory, specifically 6 complexity principles, and that you would like to discuss with them how this might be so.
4. Use a flip chart to write down each of the 6 complexity principles as you come to them in the following discussion. Or you may wish to put some of the following key points on several PPT slides. Go through each one in turn:

Self-organisation/emergence:

Ask the group if they felt any particular person was in control of what was happening during the exercise or if anyone knew what the outcome would be in advance. Get them to discuss this a bit and talk about what happened. The overall answer should, however, be 'no, no-one was really in control, and outcomes emerged – they were not planned and could not be predicted' – back this up with examples of what happened in the exercise. Tell the group we can call this 'self-organisation' and 'emergence', where people are getting on with their own individual objectives, while interacting and with and adapting to others, and producing novel things and ways of doing things – emergence.

Additional discussion questions/info if needed:

Is any single person in command or control of the situation? No
Is someone planning and managing the situation? No
Is there any obvious hierarchy among the people you are with? No
Are people organising themselves without a 'leader'? Yes
Is this going on continuously? Yes
Are people interacting with each other in simple ways? Yes

This is Self-organisation

Because: complex systems structure themselves out of themselves; interacting elements act according to simple rules; order created out of chaos.

Can you easily predict what is going to happen next? No
Does the way people are interacting appear to be random? Yes
Do you see new stuff emerging from people's interactions with each other? Yes

Could it be that if you were to look on a wide scale there might be some patterns emerging? Yes

This is Emergence

Because: patterns emerge from interactions; patterns inform behaviour of system; new qualities arise through particular types of networks; produces higher complexity out of many simple components; each individual component outgrows usual capabilities – or, people outgrow their competencies.

Edge of chaos:

Try to have a similar conversation about the edge of chaos, and pick out examples from what just happened that illustrate creative activity and change.

Additional discussion questions/info if needed:

Is there lots of creative type activity going on here? Yes
Are there lots of transitions and changes from one thing to another?

This is the edge of chaos

Because: living networks reside in a critical phase between chaos and order where networks find creativity and stability in an optimal balance; living systems are most creative, with the greatest potential for discovering order that expresses an emergent property for the whole system, when they are living near the 'edge of chaos'; they naturally undergo transitions from current order to chaos, from which emerges new order.

Diversity: As with the first two points, discuss with the group how the exercise demonstrated the diversity of those in the group, and ask them how this reflects the reality of their day to day activities in their own working lives.

Additional discussion questions/info if needed:

Are differences between people flattened out or levelled? No
Does change happen easily? Yes
Does the way people interact and change appear flexible? Yes
Does the 'system' where you are seem strong? Yes

Diversity

Because: Networks combine the most different variants, characters, functions; high diversity creates more possibilities to react flexibly, on environmental changes; the greater the variety within the system the stronger it is; ambiguity

and paradox abound; contradiction is used to create new possibilities to co-evolve with their environment.

Unpredictability:

Throw this word at the group like a question: “Unpredictability?” And see what they say… If anyone argues that based on the rules of the game and each person’s instructions that events could be understood to have some level of predictability, then challenge this and ask to what level of detail prediction could be possible. Use the example of the weather: even though we know that certain things are possible, it does not mean we can always predict what will happen, where, when, and how etc.

Additional discussion questions/info if needed:

Was the actual detail and order of the outcome of the exercise determined by an elite group? NO
Was anyone trying to forecast or control behaviour? NO
Were any actions isolated? NO
Could you see interlinked groups or networks with lots of people that are acting and reacting among each other? YES
If something happened in one place did you see consequences elsewhere? YES
When one thing changed did everything else change too? YES – maybe not immediately but there would definitely be some consequence somewhere.

- Due to complicated interrelations, it’s very difficult to foresee or to control behaviour of the nodes of the network, when reacting to impulses (from outside or inside the network).
- Emergent order is holistic – a consequence of interactions between elements of the system
- All systems exist within their own environment and they are also part of that environment
- As their environment changes they need to ensure best fit
- When they change, they change their environment too

History/Time:

Discuss with the group the way the instructions were carried out during the exercise and how they were modified as time went on, due to the interactions of others and the consequences of other actions. Elicit some examples.

Additional discussion questions/info if needed:

Could you go back in time and change something during the exercise so as to better fulfil your instructions? NO

What decisions did you make that have brought you and the group to where you ended at the end of the exercise?

- In a social context, the series of decisions which an individual makes from a number of alternatives partly determine the subsequent path of the individual;
- Before a decision is made there are a number of alternatives – after, it becomes part of history and influences the subsequent options open to the individual.
- Unique histories mean every decision the organisation makes is context specific

Pattern Recognition:

Tell the group that by looking back at where we have come from we can start to make sense of where we are now – even though this is always constrained by a subjective perspective and limited information.

Ask the group to think about what their next steps would be if they were thrown back in the exercise situation again now, having had time to reflect on what happened. Draw them to the idea that although they can't change anything that happened in the past, they can certainly be more prepared to adapt and change in the future.

Additional discussion questions/info if needed:

Can you always see direct and proportional links of cause and effect? NO
Are people and groups really linking in random ways? NO
Are small numbers of people loosely coupled to others? YES
Are small changes amplified? YES
Can you see big effects coming from small changes? YES
Can you see patterns of activity being repeated over and over again? YES

- Complex systems are defined in terms of rich interconnections between diverse components
- The ways agents in a system connect or relate to each other is critical to the survival of the system - from these connections patterns are formed and feedback disseminated, r**elationships between agents** are more important than agents themselves
- Self-organised, living networks always show similar patterns.
- Feedback is the systems way of staying constantly tuned to its environment and landscape and enables the system to re-adjust its behaviour.
- In far from equilibrium conditions change is non-linear, so small changes can be amplified, and produce exponential change

- Networks are able to provide stability, while reaching to changes and impulses of the environment
- In case of disturbances networks change the patterns of the interrelations of the nodes, the more complex, the more options for change
- Novel, emergent order arises through cycles of iteration in which a pattern of activity, defined by rules or regularities, is repeated over and over again, giving rise in coherent order.
- Structures are produced by different historical events and unique interactions
- Through feedback loops (positive and negative) incidences may produce an unpredictable resonance; the chaotic state has a distinctive pattern to the fluctuations in variables – pattern changes as order begins to emerge from chaos

After all this it is time for a well-deserved **Coffee Break**!

Come back to the group after the coffee break and ask them in pairs to think of two examples from their own practice in human-technology-environment systems that illustrate each of the following: self-organisation, emergence, edge of chaos, diversity, unpredictability, historicity/time, and pattern recognition. Facilitate this part of the exercise by walking round and chatting to each pair or group while they are working, and help them understand the 6 principles a bit more. Then bring the group back together after about 15 to 20 minutes, and spend about 15 minutes facilitating a group discussion on the examples given.

Let each pair explain their own examples, and try to get a bit of debate going. By this time people are ready for another **Coffee Break**!

Following this break it is time to start to bring the workshop to a close by discussion possible implications for AWRM and drawing conclusions. A good question to raise might be, 'If this is the case, what does it mean for you?' About five or ten minutes should be spent on this.

NB: Important advice for implementation in groups larger than 12 people, and especially in those where 25 people are present:

In this case there should be either 2 facilitators and following the social simulation the group should be divided in two for feedback purposes, and then brought together again for group discussions; or, if only one facilitator is possible, not so much group discussion and more input from the facilitator. This is because the larger the group is the more difficult effective discussion is to manage. Obviously the former option is better when possible.

Who will implement?
An external facilitator should implement the social simulation and workshop with the people in the organisation(s) in question where possible.