# Mixing methods for risk communication and management in the Hawkesbury Water Reuse Scheme[1].

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## Abstract

The Hawkesbury Water Reuse Scheme, and the community of workers, students, and passive users of the University of Western Sydney's Hawkesbury Campus, covers a diverse set of people, practices and perspectives. The case of different perceptions regarding risks associated with water reuse on the campus is a good example of a 'messy' and complex situation, differentiated by communities of practice, worldviews, and behaviours. This paper presents a preliminary report of 'work in practice' in mixing different methodologies to investigate and engage the University community in identifying practical strategies for effective risk communication and management.

**Keywords:** mixing methods, risk communication and management, water reuse.

## Introduction

Methodological pluralism is recognised as a core value of critical systems thinking and practice, along with improvement and critical awareness (Midgley 1996, 1997). Following the development of the 'system of systems methodologies' (SOSM) (Jackson and Keyes 1984) and debates in the systems literature, the importance of informed and pluralist methodological practice is reflected in 'total systems intervention' (Flood and Jackson 1991) and multimethodology (Mingers and Gill 1997), along with other more recent works. From a

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different ‘systems’ background, the field of system dynamics has also being influenced by soft systems approaches and soft operations research (soft OR) as reflected in the work of Maani and Cavana (2000). In engaging with the complexities of environmental management, opportunities are being sought to practically utilise analytical, interpretive, and critical tools to complement one another in processes of inquiry. An example includes a ‘cascade’ of methods used to investigate opportunities for investment in stormwater and wastewater in Sydney (Attwater 2000, Attwater et. al. 2002). To achieve a coherence in application, and to attempt to overcome problems of incommensurable assumptions and underlying philosophies, great care needs to be taken, particularly when attempting to bridge distinctly different disciplinary perspectives. Systems thinking and practice has potential to contribute significantly to the way in which traditional, rigorous, innovative, and developing techniques are combined.

This paper presents a preliminary report of ‘work in progress’ regarding a developing application which attempts to utilise a range of methods as part of a systemic inquiry. The focus is in investigating the perceptions regarding risks associated with recycled water by the range of ‘communities of practice’ who work, study and coincidentally use the Hawkesbury Campus of the University of Western Sydney.

## The Hawkesbury Water Reuse Scheme

The Hawkesbury Water Reuse Scheme incorporates an established effluent reuse scheme with a new initiative to harvest and reuse urban stormwater runoff. This Scheme is on the Hawkesbury campus of the University of Western Sydney and seeks to research, develop and promote innovative and practical means to reuse water on the urban-rural periphery and regional townships (Simmons, Attwater and Booth 2000).

In the provision and use of treated effluent and harvested stormwater to the range of user groups within the Hawkesbury Water Reuse Scheme a range of risks and hazards occur. These relate to the particular users of the resource, managers of the system, sub-contractors who work on the site, the general staff and students on campus, and the general public. There is a diverse community on the campus grounds who need to be aware of the risks they face from recycled water depending upon their behaviour and activity. The Environmental Management Plan for the Reuse Scheme (UWS 2002) clearly identifies the need for risk management grounded in communication, awareness raising and training for water users and the broader university community. A study has been undertaken of the health risk factors, supported by a risk management model to facilitate effective and accountable management of health risks (Derry et.al. 2003).

The Water Reuse Scheme's Environmental Management Plan and risk assessment to date clearly point to the need for proactive action research to understand the levels of awareness and perceptions of water reuse, and promote attitudes and behaviours which reduce risks to the diverse community groups within and surrounding the Hawkesbury campus. The resulting 'learning' can then be used as a base for wider safe and sustainable application of treated effluent and stormwater re-use across Western Sydney and other regions.

## Risk management and water reuse

While water reuse is recognised as a valuable strategy, a key limitation are the health and safety risks associated with operation and use. A risk management approach is fundamental to the current application of the National Water Quality Guidelines (ANZECC 2000). The way in which hazards are perceived and reacted to, or tolerated, is fundamental to safe and sustainable water reuse. This includes both the awareness, behaviour and therefore potential exposure to risks by the range of stakeholders. "Risk management (AS/NZS 4360: 1995) is defined as the *systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring risk.* A risk-based approach includes the identification of hazards and the assessment and management of risk; where hazard is defined as the potential for an undesirable consequence or impact and risk as the overall measure of the consequence and frequency of a hazard." (Bannister et.al. 2000). Perception of risk and risk communication lie at the core of the risk management cycles, underpinning each of the components of hazard identification, risk assessment, policy development, policy implementation, and evaluation (Derry et al. 2003).

A review of effluent irrigation by Fegan, Gardner and Blackall (1998) concluded that published literature provided little epidemiological evidence of significant risks to health from the reuse of wastewater. Rynne and Dart (1998) argued that quantitative microbial risk assessment was necessary, though difficult. They suggested an alternative use of decision-trees of quantitative risk, based upon treatment and irrigation methods. For the case of risks associated with drinking water supplies from source through to the consumer, Bannister et.al

(2000) have described a semi-quantitative approach based on facilitated workshops to capture experience and judgement of operators and management in managing risks associated with drinking water supplies. Based upon these works, a relevant methodological approach would be to use decision trees and participative workshops as a means to develop an understanding of risk perceptions in relation to particular activities and experiences of different groups within the community of water users, University, and visitors to the Campus.

While there are a growing number of recent studies relating to community acceptance of recycled water, there are no known Australian case studies of the perceptions of risk in reuse systems where both recycled effluent and recycled stormwater are combined. The Hawkesbury Water Reuse Scheme is a potentially significant case study, particularly given the complexity of the community of people at varying risk within the university campus, and the strong local linkages with the Richmond community within the stormwater and effluent catchments.

**The developing methodology**

The combination of methods and techniques to be used will include:

1. Overall structure of mixing methods in an action research framework, grounded on experiential learning cycle;
2. A randomised sample survey of larger 'communities of practice', ie students and staff, using a questionnaire structured in terms of a defined set of information needs;
3. Focus groups for smaller 'communities of practice' to identify qualitative responses to similar themes;
4. Analysis of information contained in responses using both descriptive and inferential methods, and including decision-tree and causal loop modelling for focus groups,
5. Workshops with 'communities of practice' members to clarify and validate mixed models developed, and determine implications for risk communication strategies.

In this way, systems thinking and methods will be used at two levels. Firstly, an action research framework, based upon experiential learning, is being used as an organising framework for the entire process of inquiry, and the logic of how the mix of methods occurs. Also, modelling tools from soft system dynamics, such as causal loop modelling, will be used to contextualise information collected in terms of key variables and points of leverage. Participatory workshops will then be used to test these models, and determine the implications for practical risk communication.

**An overall action research structure**

The proposed methodology builds upon an established model of experiential and adult learning, Kolb's learning cycle (Kolb 1974). This is a commonly used schema which can be used to underpin action research and systemic inquiry into natural resource management (Wilson and Morren 1990). Steps of an interpretive inquiry can generally follow through this learning cycle. The methods to be used in this study can generally be arranged in terms of their role in systematically moving through and building upon the different types of learning competencies reflected in Kolb's schema (Figure 1).

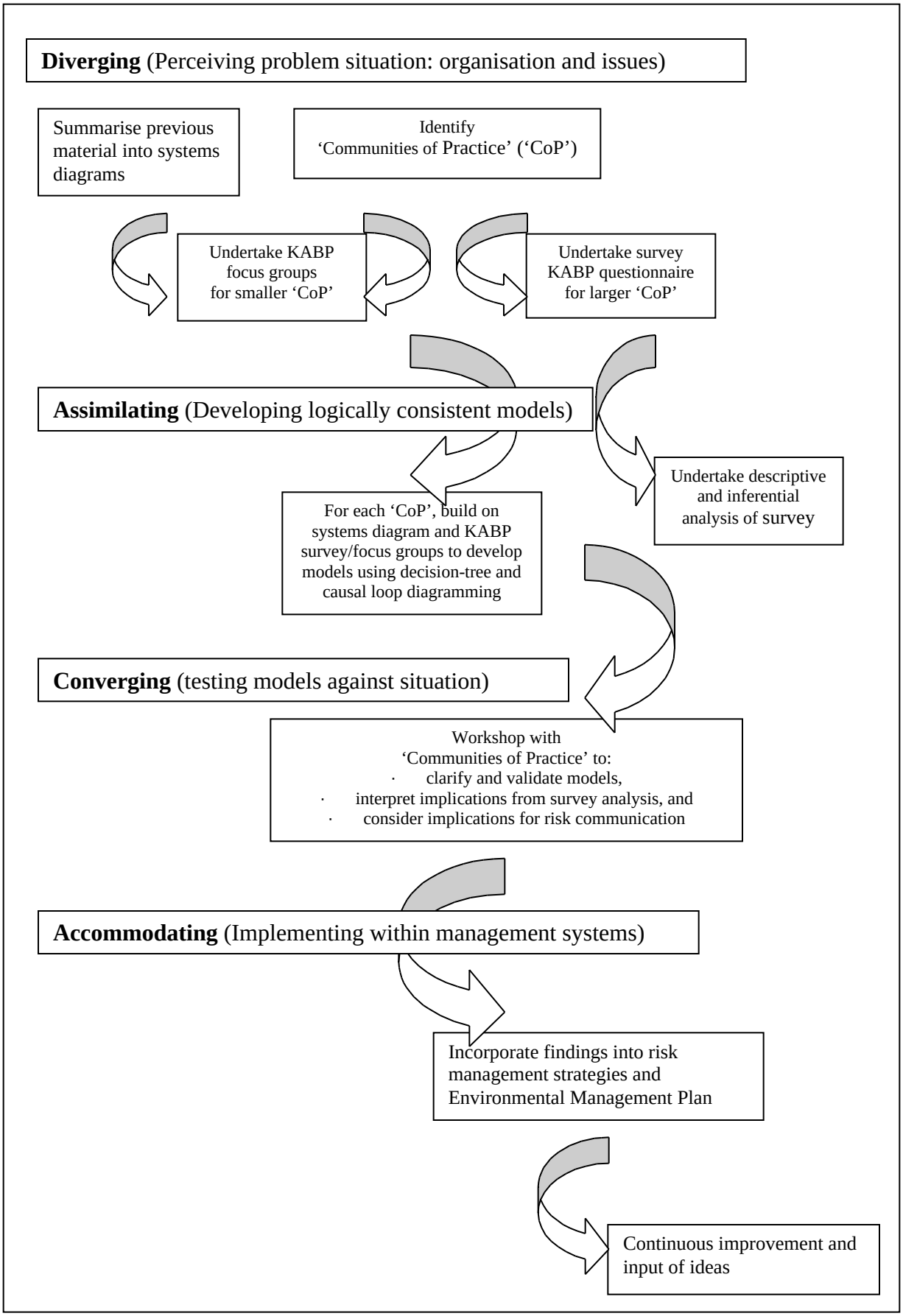


Figure1. Methodological cascade and Kolb's learning competencies

**An initial systems diagram and "Communities of Practice'**

An initial systems diagram of the known health risk factors associated with the Scheme is presented in Figure 2. This is based upon a schematic which indicates the different general components of the Scheme and a number of key areas in which the recycled water is used. Overlaying this physical base are a simplified number of health risks identified in the preliminary health risk assessment by Derry. This initial systems diagram will be built upon with additional overlays reflecting issues, perceptions of different 'communities of practice', and purposeful activities to communicate and manage risks.

Differentiated perceptions of risks associated with the Scheme are being identified on the basis of a number of 'communities of practice'. These are assumed to have similar groups of behaviours and practices, to clearly differentiate between workers with direct and ongoing contact, and more passive groups who may or may not be aware of the Scheme at all. These are also differentiated on the basis of their size, and therefore methodological approaches appropriate. These include:

- The large 'communities of practice' of students and general staff, who will be initially engaged through a questionnaire survey to gain a representative sample of attitudes,
- The smaller 'communities of practice' of workers involved with the College, UWS Dairy, Hawkesbury Union, the Childcare Centre, and people involved with Hawkesbury Skillshare, who will be initially engaged through focus groups.

**Survey and focus groups focusing on KABP assessment**

In addressing the perceptions held across the larger 'communities of practice', of students and staff, a structured survey questionnaire has been designed. The questions are structured on the basis of KABP (knowledge, attitude, belief, practice) as an established method for epidemiological and risk assessment studies. With smaller 'communities of practice', such as workers at the UWS Dairy or the UWS Childminding Centre, the initial survey of perceptions will be through focus groups. Key questions will pursue the information need as those presented for the sample survey.

In KABP assessment, measurement of knowledge and knowledge change is often possible in terms of structured tests, although specific criteria must usually be established to identify local aspects of the knowledge being measured. In this regard surveying should involve community members themselves, who, after suitable training, will be in a better position to interpret community responses than the risk assessor who can focus on the analysis and presentation of generated data for further community comment. Development of question criteria also needs to be a group interactive process if ambiguity or observer bias is to be minimised (Katzenellenbogen et al 1997). A well established method for assessment of attitudes and beliefs are Likert scales where respondents indicate concurrence with developed normative or value statements using closed responses (DeVellis 1991). Behaviour and practice can be assessed indirectly in terms of measurable outcomes relating to proxy indicators. Results based on survey responses alone may be distorted by individual perceptions of social responsibility and recall difficulty, which can show considerable variation between individuals. In this regard community involvement is again invaluable in providing a richer, qualitative background for the meaningful interpretation of results. For interpretation of results, community members again need to be involved, and so the survey will be followed by workshops.

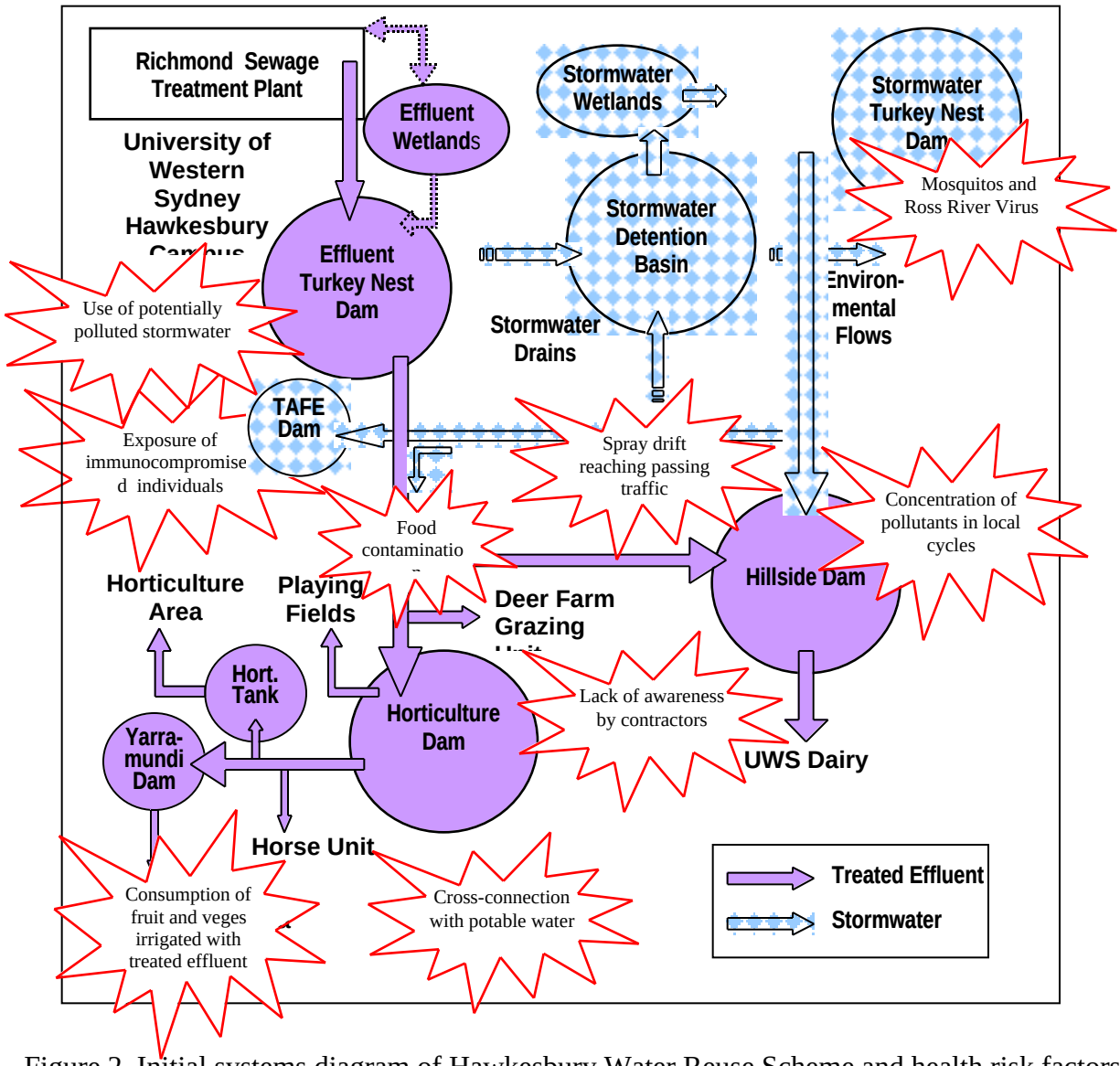


Figure 2. Initial systems diagram of Hawkesbury Water Reuse Scheme and health risk factors (after Booth et al. 2003, Derry 2002).

While gaining valuable data KABP assessment is simultaneously a vehicle for the communication between stakeholder groups of ideas relating to risk and in this regard the term "no survey without service" was coined in early WHO surveys in which KABP techniques were being applied and developed (Vaughan, Morrow 1987).

**Modelling the key relationships between perceived risks and behaviours**

Some modelling tools will then be used to attempt to understand the way in which the responses from the 'communities of practice' reflect different key relationships between perceived risks and behaviours. One of the methods, decision-tree modelling, is a potentially powerful tool for characterising risk perceptions in relation to people's activities and behaviours. Also, causal loop diagramming will be used to attempt to draw out the dynamics of the relationships which emerge.

The method of decision-tree modelling as generally used (eg Gladwin 1989) combines ethnographic methods to draw out the contexts of people's decisions and actions, and then builds generalisable models which can be tested to predict the decision behaviour of groups of people. This method can provide realistic models of decision behaviour as the assumptions used in building the models are drawn from the meanings and categories used by the groups of people in question. The 'tree' models developed are hierarchical arrangements of alternatives, criteria and outcomes which can be formally tested in their use to predict the decision making of particular groups of people. The characterisation of perceptions about risk in terms of decision-trees will allow perceived risks to be contextualised in terms of the choices of activities and normal behaviours faced by different groups within the community.

**Causal loop modelling and soft system dynamics**

The development of methods from system dynamics which have been informed by soft systems approaches and soft OR includes the use of causal loop modelling for the qualitative analysis of the dynamic relationships between 'soft' and 'hard' variables. An example of this has been presented by Cavana et al. (1999) who used the following group model building methodology to explore the different worldviews associated with drivers of quality in health services. The process commenced with the identification of an appropriate organising question, then issues and concerns were generated by a participative group process using 'hexagon' shaped post-it notes as a facilitation device. Following the clustering of issues and naming groups of issues, a small number of key variables were identified for each cluster. Then links between key variables were made, and the initial version of a causal loop diagram developed. Colour codes were used to reflect issues, strength of feeling, and variables. This analysis provided the basis for a comparison of the different worldviews of the clinicians and policy managers in the health system in New Zealand.

Maani and Cavana (2000) also provide further methods for developing and analysing causal loop diagrams, including the analysis of loop behaviour over time; the identification of system archetypes (Senge, 1990); the identification of key leverage points; and the development of intervention strategies.

These methods will be used in concert with decision-tree modelling, hopefully with the emergence of models reflecting characteristics of the combined methods.

**Workshops to validate models and develop implications for risk communication**

A practical approach to convening workshops with the participants of the focus groups will be negotiated with representatives of the different 'communities of practice' and these will be used to clarify and validate the models developed, and provide opportunity for feedback and discussion of the outcomes of the KABP based focus group sessions. These discussions will seek to have participants suggest practical strategies for communication of risks and simple actions to minimise these risks.

Given the differences in sizes of these communities and the need for an approach which is as inclusive as possible there emerges an immediate need to negotiate with representatives of each organisation as to the methods used. This is expected to be particularly the case for follow up workshops, where we will need to balance the hope to engage the workers and people in their own work surrounding, while also promoting cross communication between very different groups. A series of brief structured workshop 'conversations' in each work

situation will perhaps engage more of that community in an ongoing fashion. More centralised workshops combining different ‘communities of practice’ may enhance sharing of different perceived risks, while relying perhaps more on representatives from the different groups.

**Preliminary discussion**

This paper is submitted as ‘work in progress’, and by the time of the conference we expect to be able to present some reflections based upon the application of this mix of methods. Underlying the mix of methodologies there is the hope to balance a range of different strengths of different approaches including:

1. Framing the problematic situation in terms of a range of different perspectives (and therefore worldviews) and the development of models as a means to promote a dialogue as to purposeful action. In this way the problem framing has much in common with an interpretive or soft systems approach.

2. Framing the mix of methods in relationship to a cycle of experiential learning. In this way the mixing builds upon the approaches described by Wilson and Morren (1990) mapping methodologies upon Kolb’s cycle to mix these methodologies in a reinforcing cascade.

3. The use of tools of soft system dynamics and ethnographic decision-tree modelling as tools for modelling relationships between perceived risks, knowledge, attitudes and behaviours, rather like soft systems ‘models of human activity systems’. The workshops will then try to engage the ‘communities of practice’ in recognising critical points of leverage (transformations) in leading towards purposeful and differentiated systems of risk management.

4. The benefits of complementing the focus groups and workshops with rigorous sampling and statistical inference for larger ‘communities of practice’ to ensure standard practice for risk perception studies are built upon, rather than discarded.

5. An approach to negotiate with representatives of each “Community of Practice” hopefully contributing to a sense of a mutually agreed methodology. This is important as this study wishes to contribute to both eliciting perceptions of risks, an engagement of people in identifying their own practical means to reduce these perceived risks, and to contribute to the communication of different perceived risks and strategies.

To collaboratively identify and develop means to reduce risks, a mixed methodological approach is necessary as a way to be responsive and sensitive to the way different languages of risk are used, by risk analysts and the varied ‘communities of practice’. This is a core aspect of risk communication, and an area where systems thinking and systemic practice can potentially contribute substantively.

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