Chapter 6
Opening Up Ethical Dialogue

6.1 Introduction

In the previous chapter I outlined the decision framework for a reflective ethical mapping (REM) procedure based upon the Rawlsian concept of reflective equilibrium. The following two chapters 'operationalise' this decision framework by outlining a series of practical deliberative methods that can structure and facilitate this type of coherentist ethical reflection in a group setting. Each of the methods presented in these chapters is proposed for the context of a deliberative workshop – a series of small group discussion activities run with a small number of participants over one or two days. The choice of participants is of course context specific, and these methods can potentially be adapted for both expert and non-expert use. The methods proposed are, however, principally designed with the non-expert public stakeholder in mind. I have argued that this group of stakeholders must be engaged with on these issues in order to avoid the technocratic decision-making based solely upon the voice of experts (in this case perhaps philosophers rather than engineers or scientists), and to ensure strong deliberative democratic control of socially and ethically contentious technologies (SECT).

When operationalising reflective equilibrium as a decision framework the outline procedure has four basic stages:

1. To identify relevant topics and issues for discussion, highlight relevant 'actants' – the stakeholders, natural and social systems and technological artefacts involved, to produce an actor-network of cause and effect relationships and resultant ethical issues.
2. To 'elicit' or stimulate participants to consider their moral positions and to make specific moral judgements about the technologies in question, the motivations of different actors and the 'scripts' of technological artefacts.
3. To relate these moral judgements to a series of ethical principles grounded in common sense ethics, broadly representative of different dominant theoretical traditions in normative ethics, and to iteratively discuss the implications of these principles to the judgements elicited in the previous stage. Then to recontextualise or otherwise amend these principles in light of new insights drawn from the discussion of specific political decision-making cases and specific technologies.
4. To identify strategies and options for political decision-making that are case sensitive, grounded in the consideration of principles and personal

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moral judgements; to use weighting and option appraisal mechanisms to decide between different courses of action. To consensually agree within the group as to the course of action available, and then to reflect upon these courses of action and potential issues that may arise in the future and hence where further deliberative ethical reflection is necessary.

In the following two chapters I present and discuss a series of deliberative methods that can fulfil the criteria for this sort of decision-making structure. This methodological discussion is divided into two sections. Stages 1 and 2 are discussed here in chapter 7 in the context of opening up deliberation; in the sense of describing methods that can elicit new information, reveal new conceptual categories, options and ideas, and thus illustrate the sociotechnical complexity of the SECT in question. In chapter 8, stages 3 and 4 are discussed in the context of closing down the discussion, in the sense of describing methods which evaluate concepts, identify and weight options and alternatives and reach (tentative) conclusions.

It must be noted that in the spirit of pragmatic philosophical inquiry it is not intended that these methods be considered definitive, nor complete. It represents an experimental model of ethical decision-making which can be adapted, added to or amended with further exploration, testing and context-specific reflection. The methods presented here are therefore presented as template for an ethical toolbox, where the tools can be refined, expanded or removed for different sorts of decision tasks. Also in the spirit of pragmatic inquiry, these methods are applied in context; throughout the discussion, examples drawn from empirical data collected from three deliberative citizen-stakeholder workshops are used to illustrate the Reflective Ethical Mapping (REM) procedure in practice. The case study under consideration concerns the long-term management of long-lived radioactive wastes arising from nuclear power production in the UK; and the following section presents something of a preamble – outlining the political and ethical context in which radioactive waste management decisions have been taken.

6.2 Ethics, Technology and Environment – The Case of Radioactive Waste Management in the UK

The long-term management of the United Kingdom's legacy of radioactive wastes is a controversial environmental management and technology governance issue. UK radioactive wastes result from the production of nuclear energy, the manufacture of nuclear fuels, spent fuel reprocessing, industrial applications, military activities, research and medicine. Radioactive wastes contain materials that are atomically unstable and release ionising radiation that has the potential to damage DNA, which in acute doses can cause radiation sickness and other ill-health effects, and over the longer term can increase the risk of malignant cancers in those exposed to significant doses. These hazardous end-of-pipe pollutants generated primarily from activities associated with nuclear power have therefore created significant problems for political administrations in the UK and for other nuclear producing nations throughout the developed world. To date, wastes are stored at 34 locations around the UK, awaiting the construction of a long-term radioactive waste management (hereafter referred to as RWM) facility. However, the implementation of a long-term technological strategy and site selection process for RWM facilities (referred to as 'siting') has remained a significant environmental and political challenge, with no agreed site for a facility yet decided.

Though this issue has long been a source of political gridlock (see for example Kemp et al. 1986; Atherton and Poole 2001; Blowers and Pepper 1988; Blowers 2010), considerable progress towards implementing a solution has been made in recent years. The UK Government's "Managing Radioactive Waste Safely" (MRWS) programme (DEFRA 2001, 2007; CoRWM 2006; BGS 2010) is an initiative seeking to establish a socially legitimate and technologically sound long-term solution. The MRWS programme is something of a departure from previous RWM policy strategies implemented since the late 1970s. Historically, UK RWM policy has been approached from a primarily scientific and technical standpoint. Radioactive wastes are produced primarily through industrial processes and thus have often been treated as a technical problem. The primary role of RWMOs has typically involved research into disposal techniques followed by siting processes aimed at finding suitable locations for wastes based primarily on outcomes that presented the lowest potential 'risk' according to the best available scientific evidence and technical criteria. Such an approach has been frequently criticised as being technocratic, because it fails to address significant concerns amongst communities affected by siting in their local area, alongside broader societal concerns about how best to manage these wastes whilst maintaining long-term public safety (these issues have been extensively discussed by Petersen 2001; Dunlap 1993; Peelle 1987; O'Hare et al. 1983; Blowers et al. 1991; Blowers and Sundqvist 2010). With local conflict over technocratic siting proposals for RWM facilities repeatedly blocking attempts to identify suitable sites for what are termed low and intermediate level waste disposal[1], Government adapted its approach and

[1] Radioactive wastes are classified according to the levels of radioactivity that are produced (Nirex 2002):

- **High Level Waste (HLW) –** Radioactive wastes in which the temperature may increase significantly as a results of radioactivity. Liquid High Level Waste can be in the form of nitric acid solutions containing fission products created by re-processing irradiated nuclear fuel.
- **Intermediate Level Waste (ILW) –** Has lower levels of radioactivity than the HLW and significant heat is not a factor in storage and disposal. This includes a variety of wastes such as chemical sludges, metals (mainly in the form of fuel cladding, fuel element debris, plant items and equipment), and graphite from reactor cores.
- **Low Level Waste (LLW)-** The major components of LLW are soil, metals and building materials. Low Level Wastes consist of those that are unsuitable for disposal with ordinary refuse, but within technical specification do not exceed 4 GBq (giga-becquerels) per tonne of alpha, or 12 GBq per tonne of beta/gamma activity
- **Very Low Level Waste (VLLW)** - Wastes that can be disposed of with ordinary refuse, each 0.1 cubic metre of material containing less than 400 kBq (kilo-becquerels of beta / gamma activity) or single items containing less than 40 kBq.

radioactive waste management organisations (RWMOs) such as the former UK Nirex Ltd. subsequently sought to reframe the problem as a 'socio-technical' policy issue (Flüeler 2006; Flüeler and Scholz 2004), opening up RWM policy-making to a broader range of actors and viewpoints (Lidskog 1997; Gunderson 1999; Litemanen 1996; Freudenberg 2004; Atherton and Poole 2001), and shifting emphasis towards incorporating political, psychological, social and ethical factors (Sjöberg 2003; Atherton and Poole 2001; Carter 1989; Kemp 1992; Slovic et al. 2000). This has been realised in practical terms through an implicit political commitment to sustained and inclusive public and stakeholder engagement (PSE) on social and ethical issues and the incorporation of diverse values and viewpoints into decision-making processes (Gemmell 2005; Chilvers et al. 2003; Flüeler 2005; Sundqvist 2005; CoRWM 2005; Burgess et al. 2004; Cotton 2009). Consequently, there has been a significant trend towards the use of PTA methods designed to facilitate the integration of community and stakeholder values into decision-making processes. Concerns over the health risk implications of radioactive wastes are also linked to questions of social legitimacy and procedural fairness in relation to who gets a say in how radioactive wastes are managed (Andrén 2012).

These justice concerns regard the physical attributes of radionuclides in the natural environment, but also the influence of RWM facilities on the values, perceptions, place attachments and judgements of the citizens exposed, as communities can often become stigmatised by facilities sited in their locality (Gregory and Satterfield 2002). Thus, RWM policy decisions are fundamentally ethical in character, and explicit ethical justification within the political decision-making process is required.

This notion of ethical legitimacy in the technology management processes associated with radioactive wastes has been recognised by both national and international authorities. Notably the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA) defined three groups of ethical issues related to RWM which have informed policy development in nuclear power producing countries (NEA 1995; IAEA 2002):

- Intra-generational equity – defined as proper access to the decision-making process for all stakeholders; transparency and accountability on the part of the relevant authorities when taking those decisions; a fair distribution of the disadvantages of activities such as those that produce radioactive wastes; the 'polluter pays principle'; compensation for affected communities.
- Inter-generational equity – defined as protecting the interests of future generations who have not (or may not be) benefited from the deployment of civil nuclear energy but may have to deal with the legacy.
- Environmental equity – a growing (though perhaps still not firmly established as yet) belief that concern should be paid not only to the welfare of human beings now and in the future but also to other living species and to the environment in a wider sense.

These so-called ‘ethical principles’ (as the IAEA defines them) were later adopted by the Government-appointed Committee on Radioactive Waste Management (Blowers 2006; Grimstone 2004) referred to as CoRWM (pronounced ‘corum’) – an independently facilitated expert committee charged with assessing the options for radioactive waste management (including deep geological disposal in an underground facility, disposal in ice sheets, in space, or subduction zones between tectonic plates). CoRWM used these principles as categories of ethical issues to be explored in the RWM options assessment process, alongside their work on engaging public and stakeholders in the examination of potential technological options.

6.2.1 CoRWM’s Work on Ethical Issues

CoRWM recognised that ethical considerations would inevitably have an important part to play in its decision making process, and so they formed a key component of a set of Guiding Principles that informed the structure of their work (Grimstone 2004; CoRWM 2004). The Guiding Principles were described as statements of fundamental core values (Blowers 2006), and applied very broadly to CoRWM’s working practices, intentions and their approach to the PSE process (Blowers 2006; CoRWM 2004):

- To be open and transparent
- To uphold the public interest by taking full account of public and stakeholder views in our decision making
- To achieve fairness with respect to procedures, communities and future generations
- To aim for a safe and sustainable environment both now and in the future
- To ensure an efficient, cost-effective and conclusive process.

At the heart of these guiding principles were an underlying set of ethical values, specifically codified as working practices. However, these principles are provide codes of conduct rather than tools for the assessment of ethical criteria in relation to decision-making over which technological option to choose. It was important for CoRWM to clearly state the principles that underpinned their procedures. However, these principles alone were insufficient for assessing the wide ranging issues involved in participatory technology assessment. Thus part of CoRWM undertook specific work in this area of technological and environmental ethics.

During CoRWM’s PSE programme, the ethical concerns associated with RWM options were identified. The criteria used for short-listing options therefore specifically incorporated ethical aspects from the start. CoRWM began by gathering feedback from PSE events involving roundtables, open meetings, citizens’ panels and the national stakeholder forum, as well as a wide range of written and website responses (Blowers 2006). Also, ethical discussions of the option assessment specialist panels took place on a range of topic areas (including safety, transport, site security, environmental and socio-economic impacts, implementability etc.) and these were a key aspect of the multi-criteria decision analysis (MCDA- itself a form of Technology Assessment) process undertaken for choosing amongst the different options available.

CoRWM's programme of specialist ethics and social science input was linked most directly to a stage they termed 'Holistic Analysis', that broadly took account of combined technical knowledge, PSE input and CoRWM members' views on a range of issues such as storage lifetimes, the extent to which institutional control over a facility could be guaranteed into the future and the option to retrieve the waste from an underground facility (CoRWM 2006). They used MCDA to address ethical issues directly, and through the weighting of outputs, the implementation recommendations (which involved interim surface storage of radioactive wastes followed by long-term deep geological disposal) drew heavily on ethical input (Collier 2006; Blowers 2006).

In September 2005 CoRWM held an external ethics workshop, and this was to be the main vehicle for specialist input on ethical issues (ibid). It brought together Members of CoRWM and various UK and international specialists in the ethical issues associated with radioactive waste management (including philosophers and sociologists). The overall aim was to "explore the ethical aspects of radioactive waste and in doing so to (Blowers 2006):

- Help [Members] understand the importance of ethical considerations and how they may be taken into account;
- Inform and generate discussion on ethical issues to enable CoRWM, stakeholders and the public, to think about the ethical aspects of the different options for managing radioactive waste, and thereby;
- Provide an input into the PSE round associated with options assessment and to reflect on outputs from earlier rounds of PSE;
- Understand how ethics need to be integrated with scientific outputs in a process of holistic decision-making".

This workshop involved firstly developing a 'briefing pack' of CoRWM and participants' perspectives. The workshop itself took the format of a series of presentations and discussions on four main topics (Blowers 2006):

- In what ways is radioactive waste an ethical issue?
- Inter-generational equity
- Intra-generational equity
- Ethics and environment

After a process of deliberation, external participants were also asked at the end for their intuitive preference amongst the short-listed options. Following the workshop, a report was made along with a video that was subsequently shown to a series of Citizens' Panels (Collier 2006). This initial workshop was then followed by two option assessment 'ethics sessions'. At a plenary session in 2005 CoRWM Members considered the pros and cons of the short-listed options against a set of ethical tests based on the concepts surfaced at the workshop. The plenary then considered the options against a set of environmental principles based in part upon the workshop outputs. As a result of the specialist input to the options assessment process and the feedback from the PSE programme, these events (and the feedback that followed) led CoRWM to conclude that, “all in all, the ethical dimension of decision-making has played an integral role in the CoRWM process” (Blowers 2006).

In many respects, the ethics programme that CoRWM implemented was a success. Input from the public through the PSE phases and then specialist input from experts was incorporated into the decision-making process. As a result, ethics became a serious criterion for the technology assessment of different management options, and questions over aspects of intergenerational equity became a primary discriminating factor between the choice of final deep geological disposal of wastes and a long-term storage solution (Blowers 2006). Thus it could be argued that the ethical components of sociotechnical radioactive waste management design were assessed. However, in this respect the CoRWM ethics evaluation process is an illustrative example of the limitations of top-down ethics discussed in chapter 3, as the assessment process was based upon the input of specifically identified ethics experts. In CoRWM’s programme there was an early stage of public and stakeholder involvement on the ethical issues in the PSE programme; when defining the broad area of work and issues to be examined. When it came to examining specific ethical issues in greater detail for their Holistic Assessment and MCDA stages, CoRWM chose to base its ethical evaluations primarily on the advice of specialists rather than that of citizens (Cotton 2009). Adopting a similar approach towards the issue of implementing a long-term RWM strategy (at the stage of site selection) would, however, likely become fraught with both philosophical and political difficulties. As shown in chapters 2 and 3, basing decisions about RWM technology strategy and facility siting primarily upon technical expertise will likely lead to the rejection of siting proposals and to a political backlash against the RWMOs involved, as has been seen in all previous examples of radioactive waste siting in the UK, and in other developed nation contexts (Blowers and Pepper 1988; McCutcheon 2002; Kemp 1992). If the technical expertise under consideration is ethics-based rather than science-based, one could surmise that a similar process of local backlash would occur, with communities objecting to the notion that an outside body could decide not only what is safe, but also what is fair for the community in question. Thus, the case of radioactive waste management is illustrative of a need for bottom-up community and stakeholder engagement for ethical evaluation as part of a PTA process.

6.3 The Empirical Context – Examining the Ethics of Radioactive Waste Management in Nuclear Communities

In each section of the subsequent methods discussion I present some of the findings emerging from three day-long workshops held in communities in close proximity to nuclear power stations[2]. Locations close to existing nuclear power facilities were selected based upon the assumption that such so-called 'nuclear

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[2] **Workshop details:**

The workshops were held in the communities of Leiston, Aldeburgh (both in proximity to the site of the Sizewell nuclear power station in Suffolk, southeast England) and Hartlepool (home to nuclear power station currently being decommissioned and a neighbouring community to the town of Billingham, a previously proposed ILW facility site in the north-east of England).

Aldeburgh and Leiston workshops

The first community workshops were held in the Suffolk coastal town of Aldeburgh on 3rd February 2007 and in neighbouring Leiston on 10th February 2007.

Participants: The first and second workshops ran with 10 participants, an even split 5 male: 5 female, with ages ranging from 28-84. There were 11 participants recruited in total, 9 of which attended both sessions and 2 attended one session each (one on the 3rd and one on the 10th). In short informal interviews with participants prior to the workshop, one participant declared a strong 'pro-nuclear' stance, and two others a strong 'anti-nuclear' stance, with no other participants expressing such viewpoints. The sampling of participants was based upon attaining a broad range of perspectives on the issues, at no point was the workshop intended to be demographically or statistically representative and this fact was made clear to participants upon recruitment. Each participant was paid £110 for their participation in both workshops (the two that attended one workshop each were paid £55).

Location: Participants were recruited from Aldeburgh, Leiston and Thorpeness in Suffolk. Both communities are within a 5 mile radius of the Sizewell nuclear power station. Given the history of local nuclear power generation and that the power station was undergoing consultations on decommissioning throughout the research period, local nuclear issues were being discussed in stakeholder engagement forums, the local media and highlighted through protest actions (by the Shutdown Sizewell campaign for example). All of this contributed to a local 'buzz' about nuclear site management.

The first workshop took place at the community hall adjacent to the Church of St. Peter and St. Paul in Aldeburgh, a town situated 3-4 miles away from the Sizewell power station. The second was held at the Fairfield community centre in Leiston, approximately 2 miles from Sizewell power station.

Focus Participants were informed that the workshop would be running over two weeks with a slightly different topic focus in each session. In the first session the focus was upon national-level RWM implementation; specifically the ethical issues around site selection, the decision-making process and any issues that would apply to the UK as a whole. The second session focussed upon local-level issues, framed by the hypothetical question, "what would happen if waste management facilities were to be constructed in the local area?"

Hartlepool workshops

Participants: The final workshop ran with 8 participants, an even split 4 male/4 female, ages ranging from 32-88. Participants were paid £80 for attendance at 1 workshop (an increase on the previous two workshops, in order to gain greater attendance following prior difficulties with recruitment). The smaller group size was based upon two factors, firstly an 8-person group was more easily managed by a single facilitator, and secondly it alleviated financial constraints due to increased participant fees.

Location: The workshop took place at the Hartlepool Historic Quay, approximately 3 miles from Hartlepool power station.

communities' could represent suitable proxies for future radioactive waste facility hosts. The site communities were locations where existing nuclear facilities were being (or were soon to be) decommissioned. It was hoped that existing engagement processes around decommissioning (including site-use consultations), would help to generate interest in the workshops and encourage participation by local community members. Local changes in land use, employment patterns, property values and regeneration strategies related to nuclear development were likely to be discussed in local political forums and the local media in the selected locations. As RWM is an important facet of the decommissioning process, it was assumed that RWM would be perceived as a salient issue for these nuclear communities. By providing a forum for participants to discuss their concerns, values and judgements, it was again assumed that this would be a suitable motivating factor to improve participant 'recruitment' in those areas (in addition of course to the small cash incentives offered).

6.4 Engagement Methods

6.4.1 Actant and Issue Mapping

When beginning to assess the ethical issues involved in the management of SECT it is necessary to begin by trying to understand who and what is involved in the development and governance of the technology itself. As previously mentioned, the concern here is upon understanding technology not solely as an asocial and amoral artefact, but rather with understanding it as socio-technical process, the features of which can be drawn out by paying attention to what STS scholars term an actor-network. The epistemology and methodology of Actor-Network Theory contain both material and semiotic components, that is, they are concerned with the co-constitutive relations between physical objects and concepts (Law and Hassard 1999). For example, nuclear power involves relationships between

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Focus: The workshop, like the second Leiston workshop, focussed upon a hypothetical scenario involving local radioactive waste facility siting.

Hartlepool was selected for the following four reasons:

1. Hartlepool's proximity to Billingham (approx. 3-5 miles), a former potential RWM facility site in the 1980's.
2. It is a densely populated area, widening the scope for participant recruitment
3. The geographic and socio-economic character of the Hartlepool area (i.e. a post-industrial town) contrasts with the comparatively affluent and rural Suffolk coastal region.
4. A suitable recruiter was found at an affordable price in the local area, thus reducing the time constraints to the researcher working alone

As I lived in a neighbouring community for 20+ years, it was felt that a degree of knowledge about local issues would help to build common ground with the participants, especially given that many had no knowledge of the University of East Anglia, the host institution from where the research was based.

politicians, technical specialists, Geiger counters, mathematical equations, computer models, technical reports, economically marginalised communities, radioactive isotopes, and so on. The breadth and depth of these human and nonhuman relations constitutes an actor-network. I posit that understanding the nature of this network, even on a relatively shallow level can be beneficial to the deliberative process of ethical reflection because it contextualises technology as something inherently conceptual, value-laden and culturally situated, as well as material and technical. By encouraging citizens to reflect upon this co-constitutive relationship, we provide a suitable platform to question the governance and control of technologies as a process that requires ethical deliberation.

In practical terms, the first aim within a reflective ethical mapping process is to encourage participants to map out these material and conceptual relationships by identifying a range of stakeholders, environments, material conditions, technological artefacts and other related 'actants', based upon the previously mentioned position of generalised symmetry in explaining actor-artefact relationships (Latour 1993). Once this series of actants is identified it is important to map out the interconnective relationships between them in order to produce an actor-network map that presents these relationships in terms that are conducive to ethical evaluation. The goal of the first stage is not to explicitly talk about ethics *per se*, but rather to 'warm up' the discussion in a manner that will facilitate ethical reflection in the subsequent stages. The reason for exclusion of explicitly ethical criteria at the start is based upon pilot testing of the methods presented in this chapter. It was clear from participant feedback on the development of these tools that non-specialist participants are not comfortable or willing to begin from discussion of what are broadly perceived as abstract philosophical concepts and arguments. The process presented here, thus begins by opening up discussion through the examination of concrete problems and specific issues that emerge through deliberative dialogue. Thus the deliberation is grounded in an examination of real world socio-technical systems in a pragmatic manner. It is necessary, therefore, to begin by talking about the issues that they find important, map out the related actants, discuss the socio-technical issues and then to reflect, at the end of the first stage, what the ethical issues might be. In the following section I discuss a series of methodological tools that could be adapted to meet such demands.

6.4.2 Mapping Tools

The theoretical basis for the first tool in this process involves attention to three different, though conceptually related 'mapping' approaches. The focus on mapping implies a process of identifying not only a list of relevant concepts, but also the linkages between them:

- Stakeholder mapping
- Concept mapping
- 'Hexagons for system thinking'

Of these mapping approaches, the first, called stakeholder mapping, emerged in the organisational studies literatures to describe techniques for identifying and assessing the effects groups with different and often competing interests have on a company or other organisation. In particular these methods focus upon the power that specific interest groups can exert, the relative likelihood of each to use that power influencing organisational outcomes and the level of interest that they hold in the outcomes of particular decisions. These groups often include consumer organisations, NGOs, suppliers or community representatives. The goal of stakeholder mapping is gauge which individuals or groups of stakeholders hold the most power to influence the actions of the organisation, and thus allow the organisation to assess which stakeholders would need particular focussed attention.

Various models of stakeholder mapping have emerged, principally in differing diagrammatic forms. What each share is an identification of different groups, and the arrangement of these groups to show their influence either on a central organisation or else to show the synergistic relationships between different interested parties. The former tend to be represented either in a matrix style dividing stakeholder groups according to their level of interest and level or influence, or else in hierarchies or 'onion rings' (Alexander 2005) that show the most influential stakeholders near the top or centre (as per the method). In the latter there is a tendency to show stakeholder relationships as influence diagrams or webs (Coakes and Elliman 1999), where the relationships between them can be lain bare. As the focus within this first stage of the reflective ethical mapping process is to identify relational rather than power influences, it is this latter approach that is adopted here.

Stakeholder influence mapping tools share conceptual similarities to the second approach on the list, termed concept mapping. Concept mapping is a diagrammatic technique for organising and communicating the relationships between concepts, theories and ideas. It has developed in the field of educational studies as a way to increase meaningful learning of academic science, building upon the constructivist approaches of learning theory. Concept mapping is based on the idea that, in a learning context, individuals use their prior knowledge as a framework for understanding and incorporating new knowledge. Thus, meaningful learning involves the assimilation of new concepts and propositions into existing cognitive structures (Novak and Gowin 1996; Anderson et al. 2004; Ausubel et al. 1978). Conceptual mapping is used primarily to stimulate the generation of ideas and encourage creative input. It is often used as an exploratory tool for brain-storming, note-taking, knowledge creation (i.e. transforming tacit knowledge of participants into an organisational resource), mapping the knowledge of groups, or in communicating complex ideas (Novak and Gowin 1996). The mapping process involves generating and recording concepts, enclosing them in circles or boxes, connecting concepts with a line or arrow, linking two or more boxes together. Linking words or phrases specify the relationship between the two concepts, whereby an individual 'concept' is "…a perceived regularity in events or objects, or records of events or objects, designated by a label" (Novak and Cañas 2006). The label for most concepts is a word, although sometimes symbols such as + or %, or more than one word is used. 'Propositions' can be defined as, "…statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected using linking words or phrases to form a meaningful statement. Sometimes these are called semantic units, or units of meaning." (Novak and Cañas 2006).

Concept mapping is a useful tool for group deliberative procedures as it outlines issues, shows clarity in the inter-relationships between them and simplifies communication of the identified relationships to an outside audience. One potential problem, however, is that concepts are inter-related in a static way. If a concept is written down and then joined by a linking label it becomes fixed. Rigidity is not conducive to the iterative development and reflexive change that strengthens deliberative dialogue. Hence, a moveable concept map is preferable to a drawn (and hence fixed) concept map. In light of this, I move on to consider a similar mapping tool called 'hexagons for systems thinking', which overcomes this limitation.

6.4.3 'Flexible' Concept Mapping

Dialogical processes amongst groups of participants tend to occur in an unstructured and linear fashion. In other words, conversations tend to move freely from one topic to another without a predefined focus or central concept to bring the disparate aspects together. In some qualitative and deliberative methods (focus groups for example) this can be both a benefit and a hindrance. As a deliberative process develops it increases in complexity as more information, values and concepts are brought in to bear on the issue under consideration. Linear dialogue is 'free', unhindered by external framing effects from researchers or other bodies implementing such activities. However, in a participatory-deliberative decision-making context, unstructured and unrecorded linear dialogue places an excessive burden upon the memory of the participants to recall the different topic strands and to hold these together in the mind (Kaner et al. 2007). Some dialogical processes rely heavily upon the memory skills of participants to maintain discussion focus, or else upon those of the facilitators to guide discussions. Psychological research has shown that when tracking conversations memory alone is an inefficient medium when unsupported by visual representation (Miller 1956; Avons and Phillips 1987; Kikuchi 1987; Phillips and Christie 1977). To counter the limitations of individuals' attention span and memory, group discussion statements in meetings, workshops or focus groups tend to be recorded on paper flip charts, white-boards, or computers. Visual recording improves the recoverability of the conversation, allowing third parties to review the outcomes of discussion. Hodgson (1992) suggests, however, that although the outputs are recoverable, the generation of a checklist or diagram produces inflexible results, in the sense that utterances, ideas and concepts become fixed, either in a particular shape (such as diagrams) or in a particular order (such as in a list). Conceptual mapping, mind-mapping and other similar group brainstorming techniques share this problem of rigidity.

Hodgson's answer to this problem of inflexibility is what he terms 'Hexagon Modelling'. As a method, it shares similarities with Buzan's (2003) Mindmapping or De Bono's (1985) Lateral Thinking techniques; and like these it has tended to be used largely in business and managerial contexts for brainstorming, strategy development and planning. Where the hexagon method differs is in style of implementation: using a series movable hexagons for capturing ideas - a flexible, visual medium for handling conversation content, as opposed to the static pencil-and-paper conceptual modelling techniques.

The hexagon method involves asking participants in meetings or deliberative discussions to write out on separate hexagonal shaped cards a series of key system concepts that relate to the problem situations under consideration. These hexagons can be simple post-it style sticky notes, or more sophisticated magnetic rewritable plastic hexagons or computer models. Either way, the participant is then instructed to group these hexagons into semantically contiguous groups, and to provide these groups with a category label. Once these clustered groups have been formed (using in Hodgson's model a maximum of 15 hexagons), then the participants are asked to draw links, i.e. arrows, between the hexagons or clusters that denote the most important relationships, causal or otherwise, between concepts. In practice the hexagon modelling process is divided into stages:

1. The initial phase involves recording individual ideas and potential solutions onto separate hexagons.
2. The hexagons are then clustered into groups around specific issues and then labelled in groups called "issue maps".
3. The issue map is used to create an 'influence map' whereby the relationship between two issues is detailed on a third linking hexagon. Where 2 hexagons are touching, there is a question of what would fit into the interconnecting space, also touching these two hexagons.

In a hexagon model, different colours represent different types of thinking in the problem-solving process shown in Table 6.1 (Hodgson 1992; Hodgson 1994):

Table 6.1 Hexagon mapping categories

Yellow	Lateral thinking	Opportunity spotting
Green	Imaginative thinking	Innovation
Purple	Strategic thinking	Directing
Red	Decision thinking	Action

Hare et al (2002) suggest that the hexagon method can quickly elicit ontological, relational, and general structural knowledge about contrasting systems from groups or individuals, and incorporate it directly into a graphical model for further discussion. It provides an engaging (and colourful) visual memory aid and a means to assess the mental models, i.e. the symbolic representations and explanations of individual participants' thought processes in understanding an external reality that users draw upon in their discussion. Hodgson's approach involves combining the three aspects of interactive and mobile representation, "effective thinking frameworks as transitional objects" and interactive facilitation skills (Hodgson 1994). In short, the advantages of the hexagon modelling technique lie in the straightforward approach, use of systemic conceptual modelling, colour-coded representation of concepts and flexibility of the hexagons concept models throughout the development of the discussion.

6.4.4 Adapting the Hexagon Method for the Consideration of Ethical Issues

Hodgson's hexagon model format is unsuitable in its current format for ethical deliberation. It is structured around a series of related concepts and aims to identify the different kinds of thinking (strategic, lateral etc…) involved and conceptually map them together, drawing inference between linked concepts with no explicit reference to ethics. The main strength of the system therefore lies in its visual representation rather than conceptual content.

In adapting the hexagon method, I present a model concerned with mapping out the relationships between the socio-technical issues identified by participants, followed by a problem identification or 'brainstorming' exercise identifying the various actants, a subsequent discussion of the interactions of cause and consequence that emerge, followed by the identification of specific ethical issues which can be carried forward for further discussion. The adapted ethical hexagon method has four main objectives, taken from the assessment of ethical tools and conceptual mapping processes. It is designed to incorporate the combined strengths of ANT analysis showing the relationships and 'actantiality' of both human and non-human components of actor-networks; and conceptual mapping techniques by showing the complex interrelationships between groups of diverse ideas and concepts and representing them diagrammatically; the hexagon modelling approach that allows flexibility and 'maneuverability' of concepts throughout a process of deliberation; the ethical matrix's structured approach showing the inter-relationships between ethical concepts and stakeholders; and the discursive flexibility and colour-coded ethical concepts used by the ethical grid.

By combining these aspects, the idea was to develop the conceptual mapping approaches to specifically accommodate ethical reflection and discussion and also to break free of the confining grid (or matrix)-like structures of the aforementioned ethical tools. In this way, the first method uses a series of colour coded hexagon-shaped writeable sticky-backed notes or magnetic hexagonal discs. Each of the hexagons are given a colour category, for example in the format shown in Table 6.2.

Table 6.2 The structure of the hexagon method

1.	Issue identification	Map out the issues, questions and concerns of the participants in relation to the SECT in question	Blue
2.	Actants	Identify the actors, objects, beings, environments etc. that are affected by the management and implementation of the SECT	Yellow
3.	Actions, behaviours, intentions and procedures	Identify the possible intentions of actors, and the 'scripts' of technological artefacts: showing stakeholder relationships, motivations, procedures and rules, and influences on other actants within the network	Pink
4.	Consequences, outcomes or effects	Identify the potential consequences and outcomes of the actant relationships, and how this leads to further actions	Orange
5.	Ethical question and issue identification	Suggest the ethical implications of stakeholder cause and consequence interactions and raise points for further discussion	Green

The first category of hexagons represent the issues under consideration. This problem identification phase lays the groundwork for subsequent deliberation, providing a bottom-up framing of the problems from a citizen perspective. It must be stated that this bottom-up framing is in relation to information provided to the participants before the deliberation begins. By providing information materials, access to expert testimony and opportunities to question this testimony (in the manner of a citizens' jury), participants can form opinions on the issue that are deeply considered, rather than the shallow attitude assessments of focus groups. At the beginning workshop stage, the participants have a short discussion and are then handed a small stack of blue hexagons. They each individually write down the issues that they think are important to the discussion, identified from their own research and response to expert input (where available). These are then collected by a facilitator and clustered together on a board or blank wall. This clustering process is negotiated between the facilitator and the group to identify common themes and contiguous groupings of issues. Duplicates are removed or added to the cluster, and these clusters are then voted on using a system similar to nominal group technique (Delbecq and VandeVen 1971). Each participant is given a number of sticky dots to represent votes. The clustered issue groups are numbered and each participant silently gives each category of issues a number of dots. They can place the whole of their stake onto a single issue, or spread it between a number of issues. The voting process is reflective of the issue salience for each participant. Once this voting process is complete, the results show which categories of issues are transferred to another board for further discussion. The advantages of this process are twofold. Firstly, the individual identification of issues and silent voting procedure is a modified form of nominal group technique (NGT). NGT was developed as a means of problem identification and group judgement (Delbecq 1975) that avoids many of the problems involved in brainstorming or mind-mapping, where confident voices can dominate the agenda of the discussion (Rohrbaugh 1981). It essentially allows personal reflection on the importance and salience of topics without prejudice and bias emerging from groupthink. Secondly, it incorporates both opening up and closing down elements within the dialogue. New issues are raised and recorded, stimulating individual and group reflection processes, but the options for discussion are also narrowed through participant group reflection and voting to exclude those issues which are deemed by the group to be less important. This has significant advantages over attitudinal surveys or focus group methods which proscribe the framing of the issues and introduce researcher bias. This bottom-up issue framing method not only helps to reveal to researchers (and policy makers) which issues are of greatest importance, but also instils confidence in the process as being procedurally fair and transparent as the potential for external bias and coercion (in the Habermassian strategic dialogue sense) are reduced or removed.

Once this stage is complete and the clustered issues are transferred to the second board, the participants are given a second set of hexagons (yellow). This category is analytically referred to as actants (Williams-Jones and Graham 2003; Latour 1995) though it is termed ‘people, objects, places and environments’ for simplicity in a workshop context. This stage involves identifying the actors and affected groups, including future generations and the environment as well as technical and other artefacts. The identification and mapping of these elements is an important factor in the subsequent ethical deliberation process. The identification of disparate elements in an actor-network allows the participants an opportunity to evoke rich descriptions and reflections upon the role of technological artefacts in a broader social and moral context, by revealing linkages between human and non-human elements, between the natural and the artefactual.

When a series of actants have been identified through group discussion and recording it is necessary to then probe the ways in which these elements are related and the means through which they interact. The goal of the third stage is to identify the third and fourth categories shown in Table 6.2. Categories three and four are ostensibly representative of three dominant approaches to normative ethics – the consideration of action, behaviours and personal characteristics (representative of deontological and virtue ethics), and outcomes and impacts (consequentialism). By examining what the stakeholder actors do and the perceived consequences of their actions, participants can draw out a holistic picture of the decision-making context in terms of these contrasting ethical perspectives. It is important also to look at the ways in which technological artefact script agency: channelling actors to take specific courses of action or adopt certain behaviours, and conversely how actors can use technological artefacts in new and creative ways, thus rescripting the artefacts from their intended use by designers. An exploration of these relationships and negotiations between human stakeholders and the artefacts that link them is a crucial aspect of a rich and pragmatically grounded technology ethics.

Finally the last group, 'questions and issues' is aimed to assess and close down this actor network map, reflecting on which aspects of the discussion are worth carrying forwards, thus grounding the hexagon method in 'real-world' decision-making and reminding the participants of their progression throughout the discussion, providing opportunities for social learning within the deliberative process (see for example Bull et al. 2008; Schusler et al. 2003).

6.4.5 Linking the Different Elements

The advantage of the hexagon shape is the way in which different representations of relationships and linkages can be displayed through different configurations. Hexagons obviously tessellate across six sides rather that the four of a standard square or rectangular note which adds some flexibility to the visual style. Figure 6.1 shows how to represent the discussion diagrammatically, by linking the hexagons together. A ring of hexagons could represent a set of actants linked to a central ethical question, issue or behaviour. Here the idea is to show the actant/issue interaction, illustrating how different stakeholders are clustered around an issue, action or consequence with the divergent conceptual chains leading off from each stakeholder. A chain could represent a set of ideas that are linked either conceptually or chronologically and thus show a process of interactions. A cross-link illustrates how two different categories can be linked by a third, or the third joining hexagon can show a tangent where process chains diverge or coalesce. In each of these instances arrows can be drawn to illustrate the conceptual links between hexagons. These categories are not rigid. The aim is to encourage participant reflection on the issues and creative problem solving, so as long as the structure makes sense both to participants and to those third parties reviewing the outputs of the deliberation, then the method is considered a success.

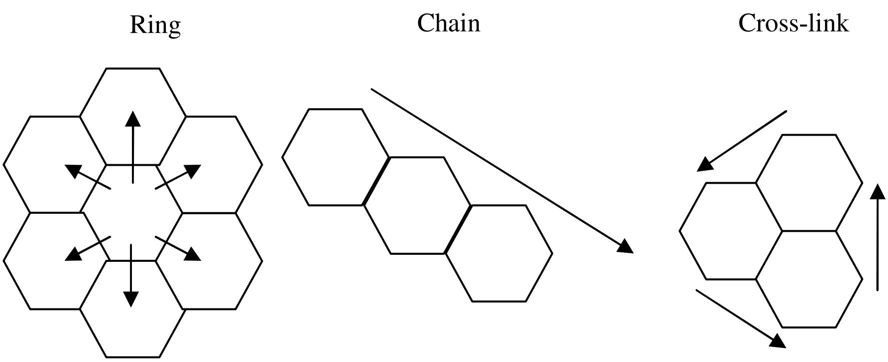

Fig. 6.1 Layout of the hexagons

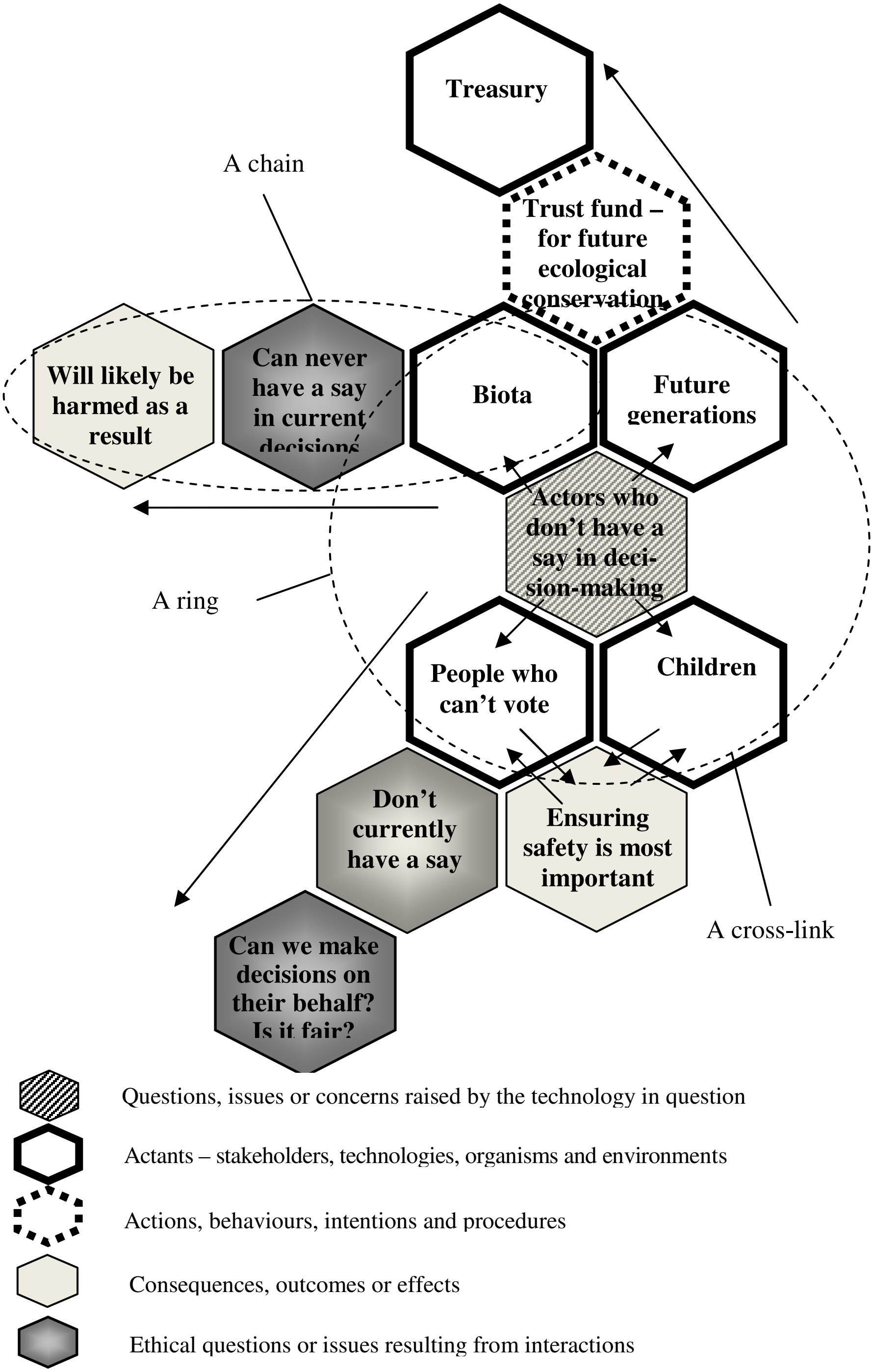

Fig. 6.2 Example hexagon map of radioactive waste management issues

Figure 6.2 shows a hypothetical example of the hexagon diagrams focussed on the issue of long-term radioactive waste management (real examples are discussed in the following section).

6.4.6 A Practical Summary of the Hexagon Method

As a practical summary of the hexagon method, it is estimated that the process should take around 2 hours in total:

- Discussion of information provided (10-15 minutes).
- Issue/question identification: each participant records approximately 3-5 of these, although it was made clear that more or less would be acceptable, each posted on flip-chart paper (10-15 minutes).
- Facilitator-led plenary discussion: highlighting further issues recorded by the facilitator on the blue hexagon notes. Thus two 'rounds' of issue and question elicitation, one that was 'from cold' and recorded by the participants themselves, and a second drawn out from the group discussions and recorded by the facilitator (10 minutes).
- Grouping or 'clustering' related responses: (either expressions of the same idea or linked by a common conceptual theme). Suggestions from the facilitator are put forward to the group as to possible groupings (if there were no forthcoming suggestions) and these are accepted, rejected or amended as a result of the ensuing discussion amongst participants (5-10 minutes).
- Voting: each participant is given a set of 5 sticky-backed dots, representing their individual 'stake' in the issues raised. They are then asked to cast their 'votes' on the salient issues (either singular issues where appropriate, or the grouped clusters) that they feel require further discussion. They are instructed to attach weight to the issues/questions accordingly, ranging from five dots on a single issue/question/cluster, to a single dot on up to five issues. (5-10 minutes).
- Actant identification: on yellow hexagons (5-10 minutes).
- Issue mapping: conceptually linking issues and actants (20 minutes).
- Identification of ethical issues related to the issue map (15 minutes).
- Second round of clustering: linking related ethical issues (10-15 minutes).
- Participant-led 'weighting' or 'voting' with 5 sticky dots on the ethical issues (5-10 minutes).
- Category labelling: selected for the following phase (5-10 minutes).

6.4.7 Real World Examples

In the following section, I present a series of outputs from the hexagon method, based upon a thematic analysis of the outputs across the three deliberative workshops. These are structured into two sections:

- Issues and actants identified
- Outputs of actant and issue hexagon maps

6.4.7.1 Issues and Actants Identified

The issues and question identification stage is designed to stimulate top-of-the-mind responses in a manner similar to opinion polls or attitude assessments. As such it is deeply influenced by the types of information presented at the start of the session, by local concerns that affect issue salience (such as in this case the decommissioning of local nuclear facilities and discussions over new build nuclear power in the case sites), and by external influences such as media coverage, the actions of NGOs, local protest organisations and political decisions, alongside myriad other external factors that shape the nature of public discourse. A thematic analysis of the outputs of the three workshops reveal a number of areas of enquiry that could be considered salient, though control for these external factors is not accounted for here. A number of issues were repeated and consensually agreed as important to the decision-making processes over radioactive waste management by participants, and are presented here to give some sense of the scope of the deliberative process. They are categorised into the following four groups:

Safety and Security

- Risk of terrorist attack on facilities, and concerns that terrorism is used as a smokescreen to promulgate a deep geological solution to radioactive wastes
- Fear over site security and potential theft of nuclear materials for profit or terrorist activities
- Safety of transportation of radioactive wastes from production sites to disposal facilities

Health and Wellbeing

- Prevention of accidents, especially Chernobyl style disasters
- Radioactive contamination of the environment and pollution of the biosphere
- Protection of future generations (both currently alive – children and grandchildren, and into the far future defined as 1000 years +)

Land Use and Technological Alternatives

- Advancements in future technology providing alternatives to disposal – such as partitioning and transmutation of long-lived radioactive wastes
- The transparency and communicability of technical and scientific criteria for site selection
- The provision of resources and incentives for scientific development of alternative energy sources, waste uses and waste management options

- Re-opening deliberation on the geological disposal option (as the CoRWM options assessment process had finished by this point)

Responsibility and Legitimacy

- Decision making authority – who makes the decision and on behalf of whom?
- Community involvement – what role do local communities play in decision-making both now and into the future, can they act as stewards for a waste facility
- Compensation – in what form, at what stage, who is offering it, and who will receive it?

What we is that these issues match those emerging from existing social research into the social and political dimensions of radioactive waste management processes (Marshall 2005; Rawles 2004; Cotton 2012; Mackerron and Berkhout 2009; Bickerstaff et al. 2008), in particular showing distinct similarities to perspectives articulated in psychometric risk analysis research on public responses to radioactive waste siting (Sjöberg 2003; Slovic et al. 2000). The issues prioritised by citizen-stakeholders encapsulated a desire to prioritise security measures to protect public safety in the face of terrorist threats and theft of radioactive materials; the prevention of nuclear accidents such as those seen at Chernobyl and Fukushima (though this later disaster had not occurred at the time of the workshops); and subsequently the consideration of alternative technologies for energy generation, thus linking energy production and waste management; the consideration of technical alternatives to deep geological disposal and issues of equity, fairness and decision-making – particularly the involvement of local community actors and the conditions under which they would accept such facilities in their local environment. In the wider context of PTA, what is important is the way in which these issues are arrived upon. To reiterate: through voting processes, these issues emerged as the most salient to the deliberative process from a bottom-up perspective of the involved stakeholders. The familiarity and similarity of the issues raised here and with broader population-representative social research into analytic-deliberative risk management in radioactive waste governance through psychometric measurement is suggestive of the socially robust nature of the approach to reveal the salient social and political dimensions of SECT.

Of equal importance is the identification of relevant actants. A second thematic analysis reveals listed groups of human and non-human elements. The results of the listing were integrated by joining them to the clustered issues that either affected these groups or upon which they had an effect. Over the three workshops the thematic list of 'stakeholders and affected parties' (as it was termed in the workshop) is compiled in Table 6.3.

Table 6.3 Identified stakeholder or 'actant' groups

Governmental organisations	Central Government Committee on Radioactive Waste Management European Union Health services Higher intra-governmental nuclear agency Local authorities Local government M.P. John Gummer (representing Suffolk Coastal district) Military NDA Nirex Police Schools Security Services The secret service Make up an independent body
Civil society stakeholders	Advocates of a community Children and civilians Scientists Human population worldwide The whole population Children Young people Host community The local population Future generations Terrorists (though these were recognised as politically illegitimate)
Objects and materials	Bricks and mortar (infrastructure) Chernobyl Electric power lines Municipal waste New energy efficient homes Nuclear power Nuclear Submarines Packaging Plutonium Sizewell power station Solar panels Spent Fuel Uranium Weapon materials Trident

Table 6.3 (*continued*)

Areas and environments	Australia France Habitats Land Other countries Scotland The local environment Animals and plants The UK England Suffolk Hartlepool Sizewell site
NGOs, independent bodies & businesses	Greenpeace British Nuclear Fuels British Nuclear Group Corporations and businesses Farmers and local food producers Foreign companies Greenpeace Pressure Groups Profit making organisations Shops and supermarkets The church The press Universities

The identified groups of actants presented in Table 6.3 illustrate the breadth of potential human and non-human elements involved in the landscape of radioactive waste management practice. The relatively broad scale of these groups effectively unbinds the ethical deliberation from consideration of predefined stakeholder groups, and by mapping together the relationships between these actants various synergistic relationships between them are more easily revealed than through a matrix structure. The types of actants identified is also important. With the exception of the group labelled ‘terrorists’, this method revealed breadth of the legitimate stakes in the policy process, which can help to frame both the ‘who’ of the engagement process for government or industry consultation on technology management, and also the ‘what’ – the types of artefacts and environments that should be considered. Though these category labels are fairly basic, and open to interpretation, they anchor the discussion to concrete elements of (a rather simplified) actor-network.

6.4.7.2 Outputs of Actant and Issue Hexagon Maps

The following discussion highlights some of the outputs of hexagon map discussions concerning two sets of issues mentioned:

- Safety, security and health
- Land use and technological alternatives

Brief sketches of discussion themes accompany the hexagon maps. These sketches or 'vignettes' are drawn primarily from the poster outputs, thematic evaluation of recorded audio and notes made during and immediately after the workshop discussions. Issues raised on the hexagons are presented in italics using the following notation:

- A – Actants
- B – Behaviours, actions, intentions and procedures
- C – Consequences, outcomes or effects
- E – Ethical questions or issues resulting from interactions
- Q – Questions, issues or concerns raised by the technology in question

6.4.7.3 Safety, Security and Health

These related groups of issues were deemed significant across all workshops. Often the issue of safety was framed in terms of twinned relationships between terrorism and the central governmental organisations involved in tackling them. One cluster emerged around the issue of terrorism (Q). Actants raised were central government (A), police (A), military (A), security services (A) and terrorists (A), which were all linked into a cluster of related groups (terrorists in the middle). Much of the discussion of UK's potential terrorist threats were framed in terms of a 9/11 style airborne attack on a nuclear reactor (hence causing a Chernobyl-style nuclear fallout scenario), or else the infiltration of a RWM facility and the theft of nuclear materials for radiological weapon-making purposes. This also linked with cross-cutting issues identified in common with environmental health and safety in areas such security of waste transport (Q) and safeguarding wastes for future generations (E).

Uncertainty over the timing and nature of an attack was a salient issue, identified as one that could affect the whole population (A), although no specific targets groups were suggested in any of the workshops. This issue was generally couched in the implicit ethical position that terrorism as a form of violence was morally reprehensible, and thus the actions of civil society actors in policy and security services to counter terrorist activity had tacit ethical justification. Participants in communities close to the Sizewell power station, questioned 'is the security good enough?' (Q), remarking that its vulnerability to terrorist attack had resulted in little change to actual nuclear operations – stating that the biggest impact that the War on Terror had had with regards to nuclear issues so far, was the closing down of the power station visitor's centre (B) (as a potential entry point for attack). This in turn sparked discussion of how information about nuclear issues had become less accessible; without that point of contact with the local community (and the UK population as a whole) locals may become more fearful (C) and distrustful (C) of nuclear power generally and RWM facilities more specifically. It was suggested that increased focus upon security issues nationwide limits the freedom and access to information on radioactive materials and thus distances local publics from scientific and technical bodies, which in turn leads to uncertainty, distrust and nuclear fear (C). Similarly though counter-terrorism was ethically justified, there was concern that terrorism is an excuse (C) to justify further expansion in the remit of their operations.

A second clustered group emerged concerning the relationship between RWM and other nuclear power-related risks. It is notable that no distinction was made between radioactive waste management, existing nuclear power, decommissioning of old reactors and new nuclear build. Across the workshops a range of inferences were made, linking issues about nuclear power (and in some cases nuclear weapons) to the issue of RWM; mirroring the findings of previous studies around risk perception and radioactive wastes that couch these technologies as dread risks (Flynn et al. 1990; Weart 1988). The Chernobyl (C) example was also used as an analogy for a RWM accident or contamination (C) event. Radiation was framed primarily in terms of the risk to children (A), young people (A) and future generations (A). There was evidence of what Douglas, Wildavsky and Dake (Douglas 1986; Wildavsky and Dake 1990) term *fatalistic* risk responses to the hypothetical situation of a nuclear explosion (C), with statements such as "if it [reactor or RWM facility] blew up we wouldn't know about it". A commonly expressed concern was that it would be those who survived and lived in the future that would bear the brunt of the costs, both in terms of economic clean-up and health risks from contamination, hence safety is most important (E) as an identified ethical issue.

Health concerns centred upon issues of leaking radiation from waste containers, decommissioned sites and power stations. Safety of nuclear technologies was linked to uncertainty (B), a concern over insufficient research into long-term radiation effects to the environment and human population and hence future generations (A). In some instances a broader theme emerged relating environmental impacts to healthy living and healthy lifestyles, relating power production from fossil fuels and nuclear against renewable energy such as wind, with the idea that the healthy body must exist within a healthy environment. Also, discussion centred on re-evaluating the concept of progress and development; challenging the accepted notion that nuclear expansion was necessary to meet continually rising energy demand. The primary ethical issue was responsibility (B): that current decision-makers and facility host communities would act as custodians of the wastes, guarding future generations from harm and ensuring long-term safety because they in particular don't have a say (C). Some participants suggested that our ancestors left problems (from technological advancement and resultant pollution) for 'us' and that we would do so in the future, thus it made little sense to try and safeguard them from the outcomes of inevitable technological progress. Others discussed how future technological developments could potentially neutralise radioactivity. Consequently, participants occasionally sought to re-open the issue of RWM option assessment, often expressing incredulity at the choice of the option of deep geological disposal. When and where this was accepted by the group, a general call for waste retrievability was expressed. A recurring theme was that community responsibilities for safeguarding wastes for future generations (B) contrasts with a sense that they would be better equipped to deal with them.

6.4.7.4 Land Use and Technological Alternatives

One area of relative conflict among participants surrounded doubt about deep geological disposal (Q), as some questioned 'what other options are available?' (Q). A minority of participants called for the reopening of the technology options assessment, while others trusted the legitimacy of the CoRWM-led option assessment process and were more accepting of deep geological disposal. This issue was repeatedly returned to throughout the workshops, alongside continual questioning of alternatives, such as disposal in outer-space (B) and immobilisation (partitioning and transmutation was mentioned). These ideas were popular because of their potential to reduce overall waste volumes or remove them from the natural environment altogether. However, with the outer-space option the issue of human error (B) and accidents (C) was raised (the space shuttle Challenger disaster of 1986 was mentioned in reference to this), and safety was considered paramount and hence argued to be sufficient justification to dismiss this option. The broader ethical implications of geological disposal were identified as an 'out of sight, out of mind' (E) problem, implying the sociocultural invisibility of risk (Beck 1996) whereby 'we can't see the risks' (C). This was construed as civil society's disregard for environmental safety, whereby the public presumes that once waste is secured below ground then it has been dealt with, and posited as a fundamentally dishonest (E) strategy. It was also identified as a global problem (E) and so comparisons were made with other environmental concerns at local levels such as municipal waste management and international levels such as climate change (C). The waste problem was often characterised as an international problem, raising questions about centralised international waste storage (B) and the exportation of waste (B) to other countries. An ethical debate about the exportation of waste ensued with two key points. Given that safety was held as the highest priority, some felt that an area with low population density but high levels of institutional control. Australia (A), the North York Moors (A) and Scotland - Mountains and Highlands (A) were all mentioned as specific areas that would be ideal for a RWM facility site, rather than the limited space (C) problem of a highly populated country, notably in England (A). This argument was countered by those that felt this was another example of the out of sight out of mind problem previously mentioned. Also, some recognised that NIMBY (Not-In-My-Back-Yard) (B) was a problem in any country and did not perceive that RWM could become safer, cheaper or more efficient in countries other than the UK. Centralised waste storage involving joint responsibility and compensation for the host country were discussed as potentially viable alternatives to a national strategy. Ownership of wastes (E) was an important factor in concluding against exportation, the burden of waste was broadly argued to be the responsibility of the producing country (or as some argued in the producing area). This intra-generational or regional equity problem (not their term) was recognised as an important aspect in accepting or rejecting a localised waste management facility siting proposal.

RWM was contextualised through comparison with pollution control across other industries. Some suggested adhering to a Polluter Pays Principle (although this exact phrase was not used) like other heavy industries and municipal waste management are obliged to do. Reduce, Reuse, Recycle, (B) emerged as a topic upon which to base the ethical justification for the elimination of nuclear new build. RWM was often explicitly linked to nuclear power as a continuous cycle of production and waste. Cessation of nuclear power would result in the reduction of waste and some argued that this should take priority. Waste's link to new nuclear power was recognised as being part of a problem of growing energy demand across the UK (and the world). The environmental benefits of lowering energy consumption were discussed particularly in terms of long-term radioactive waste reduction, as well as potential strategies for reducing demand such as replacing housing stock, investing in renewables, combined heat and power production (Micro CHP) and reducing waste heat from power stations.

RWM was framed by some in the broader context of a throw-away society (E) that was incapable of dealing with waste issues on a large scale. Climate change was a strong contextual factor, issues of energy efficiency and waste reduction, it was argued, should be addressed before proposals for new nuclear build. There was often evidence of a tacit assumption that waste management was intrinsically linked to new build and that the ethical principle of concern was that demand reduction should be the first priority.

6.5 Conclusions

The hexagon method presented here is something of a hybrid approach to ethical deliberation that draws upon existing stakeholder engagement tools to illustrate the interrelationships between heterogeneous elements of a socio-technical system, such as those involved in the management of radioactive wastes. The key issues raised by this method are accessibility and facilitation of effective decision-support. The simplicity of the method, listing individual actant categories and linking them together into conceptually contiguous groups belies the complexity with which the problem is evaluated by the participants. The intention is to visually display an Actor-Network, albeit a simple one, and in this task the method is broadly successful. The flat structure of an actor network is revealed in the linkages between the hexagons, and the method succeeds in providing a framework for relatively rich description of the relationships between heterogeneous elements. The advantage of the method also lies within its approach grounded in principle of generalised symmetry. When the different elements are broached, they are not hierarchically prioritised with certain actors at the top (such as stakeholders considered to be ethically motivated actors), and the technological artefacts and non-human biota considered to be inanimate and passive (and hence the object of the discussion).

Though this method proves useful in illustrating the socio-technical elements of the SECT in question, it does not present the means to evaluate the ethical issues inherent to its governance. Thus further tools are necessary to make implicit ethical issues explicit, and to weigh up their significance in light of a reflective process of moral evaluation; and the following chapter explores these aspects in greater detail.

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