

The Socially Literate Expert
A New Model of Risk Communication and Social Engagement
Bridging Content and Bridging Process

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Certificate of authorship/originality

I certify that the work described in this thesis has not been previously submitted for a degree, nor has it been submitted as part requirement for a degree.

I also certify that the thesis has been written by me. Any assistance that I have received from others in my research inquiry and the preparation of the thesis is acknowledged. In addition, I certify that all information, sources and literature used are referred to in the thesis.

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Signature of the candidate

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Abstract

This dissertation is about the capacity of experts to explain the meaning of empirical risk to non-experts. It asks why experts' risk communication might succeed or fail by identifying gaps in communication between the two groups, and identifies factors that can bridge these gaps.

The inquiry focusses on seventeen Australian experts who have undertaken risk communication and social engagement with non-experts about the remediation of contaminated sites located in Sydney, N.S.W.. Remediation experts investigate, characterise and assess site contamination, and apply this knowledge to address the uncertainty it poses. They do this by calculating levels of empirical risk and managing that risk. Experts select risk levels that comply with legislative frameworks and policies, and under licence, deploy destruction technologies to remove contaminants from the environment. In this way, they can generate benefits in terms of reduced pollution, reduced public health risk, improved amenity and urban renewal. The proposition that experts can and will do this is critical to the inquiry, since they might be capable of reducing empirical risks and delivering benefits, but then again, they might not be able to, due to the commercial, legal or professional constraints on their independence. Because of these constraints, experts might not be trusted by non-experts no matter how competent they are, and as a result, the credibility of their risk message can be compromised.

To bridge the communication gap between themselves and non-experts, experts must satisfy four conditions. The first is that they are capable of *the practice of trust* in the social world. No matter how credible a risk message, if people do not trust the person who delivers it, the message will be rejected. It is a case of 'we don't trust you, so we reject your message', or the converse, 'we trust you, so we accept your message'. It reduces to the two key questions around any risk dialogue: 'Who do you trust?' and 'who can you trust?'. A person can be trusted only when they can convince other people that are trustworthy. To do this, experts must exhibit sufficient competence to do what they say they can do. In other words they must be able to demonstrate proof of performance.

Three other conditions apply and they lie within the mental world of thought and experience. Firstly, experts require awareness of self and situation, secondly they must possess a sufficiently balanced *persona*, and thirdly, they must exhibit sufficient social literacy. When these three conditions are satisfied, experts have the capacity to bridge communication gaps. The issue is whether or not they will, and here, we return to the social world where *the practice of trust* comes into play.

This research inquiry explores the knowledge, understanding and experience of experts about risk and uncertainty, and finds that they have varied capacity to communicate with non-experts about them. The variation is associated with the extent to which each expert's *persona* supports a sufficient balance between their scientific literacy and their social literacy. Experts, by definition, must be sufficiently scientifically literate to undertake their specific roles, but as to social literacy, the inquiry finds that not all experts are sufficient in this capacity. Social literacy requires an expert to have sufficient knowledge and experience to understand and engage with, the socio-political and psycho-social aspects of techno-scientific phenomena, which, for this inquiry, is pollution destruction technology. When experts can balance their scientific literacy sufficiently with their social literacy, they can communicate effectively about the empirical risk its mobilisation entails.

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Glossary

The terms listed in the glossary are selected because they are commonly used in the remediation industry and in discussion about it. Other terms used in this dissertation are explained within the text.

2,3,7,8-TCDD: A highly hazardous type of dioxin. A by-product of industrial processes; a contaminant of some pesticides. *Gras and Muller (2004)*.

Agent Orange: A chemical weapon used during the Vietnam War. It contained active ingredients (a mixture of the herbicides, 2,4-D and 2,4,5-T), carriers/solvents (aviation fuel or diesel) and the dioxin 2,3,7,8,TCDD as an impurity. *Vietnam Veterans Federation and Pollak (1996)*.

Anthropogenic pollution: A situation created by the deliberate or accidental release of hazardous chemicals to the natural environment which causes unacceptable risks to human and ecological health. Author's definition: After *Stromberg (2018)*.

Broad-acre remediation: Remediation of a large area of contaminated land such as a landfill, as distinct from remediation of a small well-defined area, such as a petrol station. Author's definition. Adapted from *Pym and Sydney Olympic Park Authority (2001)*.

Brownfields remediation: The remediation of degraded and contaminated industrial land to allow for urban development. *Miller and Erikson (2013)*.

Civil society: "Stakeholders from the corporate sector, non-government organisations (NGOs), science communities as well as representatives of the public". *Gregory et al. (2006 p.18)*.

Community: Those individuals and/or groups residing in the locality where a site assessment is to be conducted and who may be affected by the assessment and/or possible site contamination physically (for example, through risks to health or the environment, loss of amenity) or non-physically (for example, via concern about possible contamination). *Commonwealth of Australia (2013)*.

Community engagement: The process of communicating and deliberating with the community and other stakeholders. It can include a variety of project-specific approaches. *Commonwealth of Australia (2013)*.

Contamination: A situation whereby (a) chemical substance/s has/have been, added to air, soil or water, as a result of indirect or direct human activity so as to cause the medium to contain levels of the substance/s above background levels, such as they represent a risk to human health or the natural environment. *Adapted from National Environment Protection Council (2013) and CRC CARE (2019a).*

Dioxins: A group of hazardous compounds that belong to a larger family of persistent organic pollutants. They share similar chemical structure, properties and biological characteristics and tend to accumulate in body fats. *Environment Protection and Heritage Council (2005).*

Environmental health: A subset of public health which focuses on environmental conditions and hazards, which affect, or have the potential to affect, human health, either directly or indirectly. It includes the protection of good health, the promotion of aesthetic, social and economic values and amenity, and the prevention of illness or injury by promoting positive environmental factor and reducing potential hazards - physical, biological, chemical or radiological. *enHealth Council (2001).*

Epidemiology: The study of the occurrence of disease. *Ahlbom (1993).*

Exposure: Exposure occurs when a chemical, physical or biological agent makes contact with the human body through breathing, skin contact or ingestion; for example, contaminants in soil, water and air. *Commonwealth of Australia (2013)*

Grey literature: A form of knowledge. Refers to research that is either unpublished or has been published in non-commercial form, and includes government reports, policy statements and issues papers. *University of New England (2019)*

Halogenated compounds: Substances that are characterised by the presence of halogens, the most important being chlorine and bromine. The presence of these elements in a compound provide it with a highly stable chemical structure. *Fiedler (2007).*

Hazard: Hazard is the intrinsic capacity of a chemical, biological, physical or social agent to produce a particular type of adverse health or ecological effect. *Commonwealth of Australia (2013).*

HCB: Hexachlorobenzene. A fungicide, a by-product of pesticide manufacture, or a POPs waste. *Australian Department of Agriculture (2004)*.

Local community: A group of people living in the same physical locality. Author's definition.

Mass media: "technological channels for predominantly one-way distribution of messages by organizations with the objective of creating and maintaining audiences for commercial or other purposes". *Macnamara (2014 p.36.)*

NGOs: Non-Government Organisations excluding private commercial organisations. Part of the large grouping known collectively as civil society. Includes organisations focused on environmental, public health and social justice issues. Author's definition.

PFAS/Perfluorinated Compounds/PFCs: Fluorinated substances is a general, nonspecific name that describes a universe of organic and inorganic substances that contain at least 1F atom, with vastly different physical, chemical, and biological properties. *Buck et al. (2011 p.513)*.

PCBs: Polychlorinated bi-phenyls. A group of POPs chemicals once used in electrical industries and now banned under the Stockholm Convention. *UNEP (2002b)*.

POPs: Persistent Organic Pollutants. A wide range of industrial chemicals that are highly toxic, persistent in the environment and animal tissue, and are globally mobile. *Adapted from UNEP (2005)*.

Regulator: A public servant with responsibility to implement laws and regulations, for example about pollution control and remediation. (Author's definition).

Remediation: the clean-up or mitigation of pollution or of contamination of soil or water by various methods. *Commonwealth of Australia (2013 p.26)*.

Risk: the probability in a certain timeframe that an adverse outcome will occur in a person, group, or ecological system that is exposed to a particular dose or concentration of a hazardous agent; that is, it depends on both the level of toxicity of hazardous agent and the level of exposure. *Commonwealth of Australia (2013)*.

Risk Assessment: the process of estimating the potential impact of a chemical, physical, microbiological or social hazard on a specified human population or ecosystem under a specific set of conditions within a certain timeframe. *Commonwealth of Australia (2013).*

Risk Communication: an interactive process involving the exchange among individuals, groups and institutions of information and expert opinion about the nature, severity and acceptability of risks and the decisions to be taken to combat them. Risk communication is delivered most efficiently in the context of a well-structured community engagement process. *Commonwealth of Australia (2013).*

Risk Perception: the subjective judgment that people make about the characteristics and severity of a risk. *Commonwealth of Australia (2013).*

Stakeholder: An individual, group, organisation, or other entity that has an interest in a decision-making process. *(CRC CARE, 2019a , p.7).*

Sustainable development: development that meets the needs of the present without compromising the ability of future generations to meet their own needs. *Commonwealth of Australia (2013).*

Key to ascription in the text.

This research inquiry draws on literature from peer-reviewed publications, from web-published content, and from a variety of grey literature. Primary sources are also used.

Double quotation marks indicate a quotation from the literature. For ease of reading, once an oft-quoted author has been identified using an EndNote reference, further reference to their work using EndNote might not be included.

Single quotation marks indicate a colloquial, novel or useful concept, word or phrase.

Quotations sourced from interview and focus group transcripts are italicized.

Sometimes, in a direct quote from the literature, the writer uses italics or underlining to emphasis a word or phrase, and this is acknowledged within the text.

Occasionally, I have underlined a section of the text as a way to draw the reader's attention to a word or phrase.

Note to the Reader.

In those sections where data from the in-depth interviews or focus group are used, I present it using a narrative style which combines individual data fragments to create sets of italicized quotes. In doing this, I apply Butt et al. (1995)'s definition of narrative, which is "to tell a story as a means of making sense of the events and happenings in the world" (p.142). This technique allows me to provide a composite narrative that reveals how different experts and non-experts consider the same phenomenon, experience or situation. It lets all their voices be heard.

The use of auxiliary verbs (e.g. might, must, could, should, would, can, will) is critical to the construction of my argument which uses abduction as the mode of inference. I make this point to draw attention to the power that auxiliary verbs have to confer potential, compulsion, motivation or timing to any act.

Data is occasionally used more than once, and in different chapters, because it is able to illuminate different situations.

In some sections, I use rhetorical questioning as a way assist the reader by signalling places in the text where I move to a new point of argument.

When I refer to 'science', 'scientists' or 'scientific research', I am referring to bio-physical scientists and the work they do.

Chapter One. Introduction.

In this chapter, I describe the research inquiry and the journey I made to complete it.

1.1 The inquiry described.

This research inquiry focusses on experts who work in the remediation industry. Remediation is a relatively new industry that undertakes the rehabilitation of damaged environments, including by the use of complex technologies. It requires interdisciplinary technical expertise to achieve its goals.

When remediation is in play, there is a need for communication between those who undertake it, and those who could be affected by the risks and benefits it poses. This inquiry explores how experts communicate with non-experts about the empirical risks that can arise during remediation. The particular risks I address are the human health risks associated with the destruction of contaminated soil or sediment by a thermal process, and the human health risks associated with exposure to hazardous chemicals migrating from a contaminated site. The pollutants of interest are persistent organics pollutants (POPs), a group of hazardous chemicals listed for destruction under the United Nations Stockholm Convention (UNEP, 2002a)

The Convention acknowledges that risks can arise during a destruction process, with Article 6 listing measures “to reduce or eliminate releases from stockpiles and wastes” (p.11). Here, the Convention allows that risks taken during a pollution destruction process are taken to achieve a benefit, since harmful substances will be removed from the environment. This connection between a risk and the benefit it might bring is a key issue for my inquiry.

Risk and benefit are considered in the literature. In risk communication studies, as the nomenclature infers, the emphasis is on risk, however, there is also research into benefit. Literature from the biophysical sciences also tends to focus on risk, although there are studies about benefit, including around contaminated land remediation in urban environments. I explore these domains of literature through a transdisciplinary approach, considering the humanities literature, as well as that from the bio-physical sciences and social sciences. By exploring literature in these domains, I aim to identify

variation in the construction of meaning about the risk and uncertainty associated with POPs remediation technology.

The research explores the meaning of competing and compatible knowledge forms about risk and uncertainty held by distinct epistemic (knowledge) communities, and identifies the shared and conflicting values associated with them. Experts and non-experts come together during social engagement as part of an environmental decision-making process about a potentially risky technology. They engage in a risk dialogue about the extent of empirical uncertainty and the selection of risk levels associated with it. When they do, gaps in understanding about the nature of an empirical risk can occur, and this misalignment of meaning can influence the outcome of the social engagement and limit its effectiveness. My focus is on identifying how experts bridge gaps in understanding by non-experts about the nature of an empirical risk associated with the destruction of, or exposure to, POPs.

There are two main lines of inquiry in the research project. One explores the knowledge, understanding and experience of remediation experts. I conducted seventeen interviews with experts, and sought other information from them via two questionnaires and an image survey. Other lines of inquiry were a media survey about the use of a key technical term, and a focus group. The focus group explored the views of non-experts about what constitutes effective risk communication and social engagement by experts.

1.2 The setting of the inquiry.

Of the many problematic situations existing in the world today, one that stands out is land and water contamination due to the presence of hazardous substances. The pollution did not happen by chance. It was the result of uncontrolled or poorly controlled industrial processes, including the manufacture of hazardous chemicals used in industry and agriculture and in peoples' homes. These processes caused contamination of air, soil and water, and sometimes the degree of degradation was so great that the land was sterilised for future use. Many of these contaminated areas are in cities, and it has been the need to find more land for urban development that has driven their remediation. In Chapter Two's review of scientific literature, references to

issues associated with land and water contamination and the risks posed to human health are provided.

My inquiry explores how experts function as communicators in situations where their overarching role is to remedy contamination. It covers their role on remediation sites, and in offices where remediation projects are designed, planned, mobilised, managed, monitored and audited. All experts have undertaken remediation projects in Sydney, and all non-experts have either experienced remediation projects in Sydney, or live near the Richmond RAAF Base, a contaminated site in the Hawkesbury Local Government area. At this site, a remediation process is in a trial phase, albeit without any comprehensive communication with the community.¹

Figure 1.1. below shows some locations of contaminated or remediated sites.

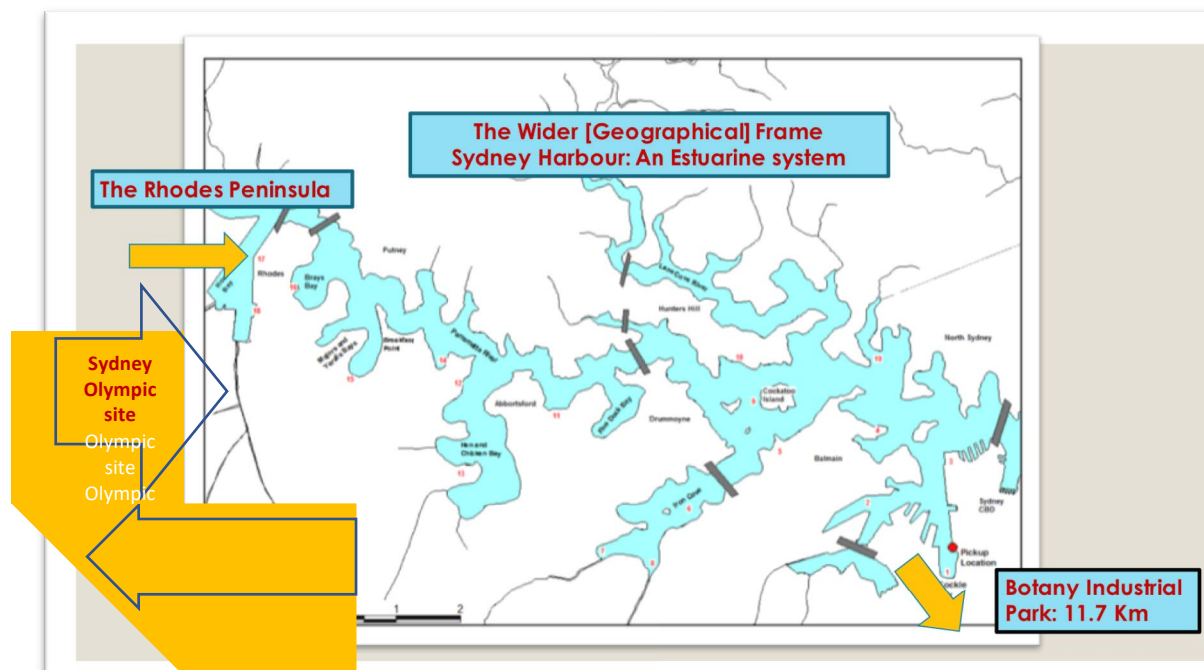


Figure 1.1. Location of some sites in Sydney, N.S.W. identified in the inquiry. Author's image library: Ecology Data Bank (Australian Securities and Investments Commission, 2018).

Let me now inform you about how I came to undertake this research inquiry.

¹ Pers. Com. Joanna Pickford. October 2019.

1.3 My research journey.

I began my research journey in March 2013 and completed it in March 2020. Prior to this, I worked in a variety of areas, beginning my career as an anti-war and anti-pollution activist, and then working as a writer, a media commentator and an independent consultant to government, industry, trade unions, the legal profession, and the NGO sector. In 2013, I was offered a scholarship as part of the CRC CARE SPART project which I accepted, resulting in the creation of this dissertation.

Before I describe some key moments in my research journey, let me inform you about my previous academic training and philosophical approach. I was trained in the humanities and received a doctorate in politics from the University of Adelaide in 1977. That training stays with me and I favour a humanistic approach to problem solving, including problems about the public health risks associated with anthropogenic pollution.

There were many challenges presented during my research journey. I encountered a mountain of scholarship, and found, in particular, some of the social science literature to be challenging. I noticed an abundance of theory, some with limited empirical evaluation and dense, often obscure language. The plethora of approaches to the methodology of inquiry was particularly noticeable, being very different to what I had encountered as a young researcher.

At the Institute for Sustainable Futures where I undertook the inquiry, the idea of transdisciplinary research is strongly promoted (Farm et al., 2018). I was initially challenged by some of the ideas it embodied, the approach it took to inquiry and the choice of language. However, as time went by, I came to understand the better part of its nature. In Figure 1.2. below, I represent the process of transdisciplinary research that I adopted. I began with a literature review of three distinct knowledge domains, and then applied the knowledge and understanding I had gained to the inquiry.

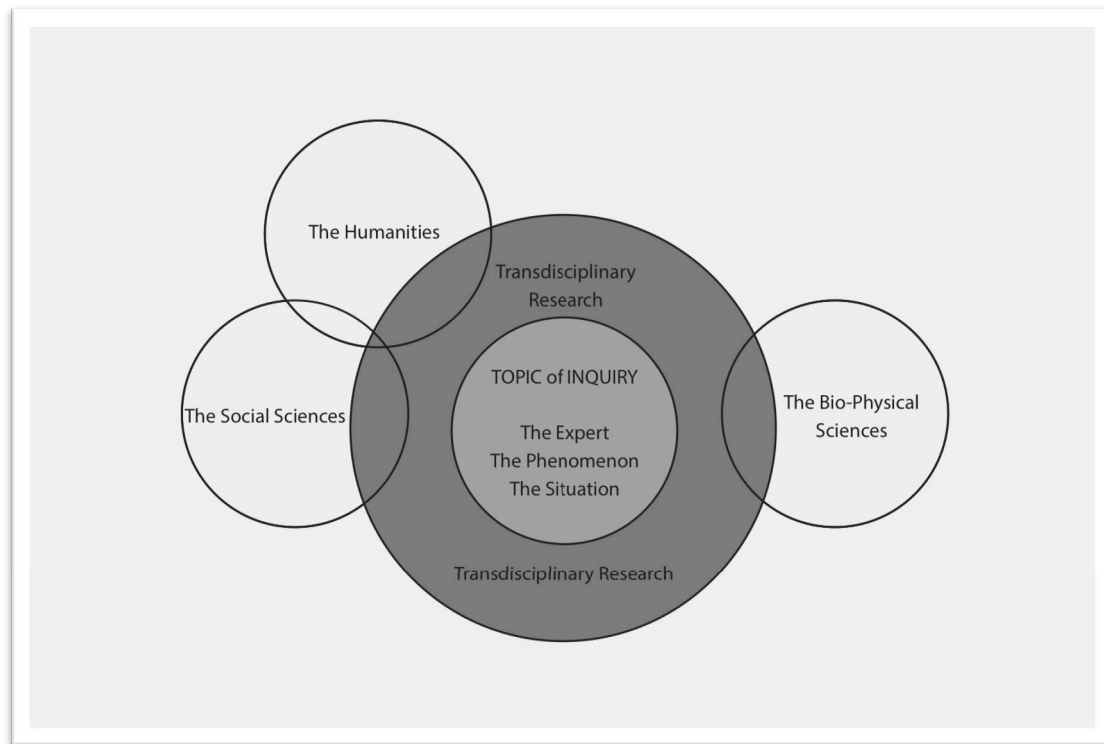


Figure 1.2. Transdisciplinary research as reflected in the research inquiry.

A key challenge was defining the scope of the inquiry. I selected experts as the unit of analysis, POPs destruction technology as the phenomena of interest, and social engagement about remediation risks as the situation.

1.4 The structure of the dissertation.

The structure of the dissertation follows a traditional approach, beginning with the literature review and a description of the research inquiry, including philosophical framework, method and tools of inquiry, and analytical techniques. Following this, there are five findings chapters. The first three concern time and values, uncertainty and trust, and the last two are respectively, about risk communication and social engagement. Chapter Nine is the synthesis chapter. It consolidates all findings, makes claims about experts' capacity to bridge communication gaps between themselves and non-experts, and proposes a new model of risk communication and social engagement based on the construct of the expert's social literacy. The final chapter provides some reflection and insights, offers an outlook for the future, explains the limitations, makes recommendations for training and identifies opportunities for research.

1.5 The style of the dissertation.

I used a mix of literary styles in this dissertation because I aimed for readability as well as academic quality. My professional competencies are in research, document review, editing, writing, advocacy, logistics and communication. Given this, it might not surprise if the mix of literary styles I use could be unfamiliar. Sometimes the text is informal, and uses rhetorical questioning as a way to signpost the flow of the argument. At other times, the text is in a formal academic style so as to ensure accurate representation of published literature, methodology and presentation of findings. In addition to text, I also use imagery to communicate the meaning of a technical or social process. Photographs were provided by colleagues, as well as the experts who were interviewed. Others were sourced from the image library of the Ecology Data Bank (Australian Securities and Investments Commission, 2018) which is my library for all things that interest me.

1.6 The opportunities to create new knowledge.

Scholarly research aims to create new knowledge and I designed my research with this in mind. At the beginning of, and during a research inquiry, one can never know if creating new knowledge is achievable. One just undertakes the inquiry and makes findings, and at the end of the process, makes claims to reflect new knowledge. My inquiry was designed to bring forward new knowledge about the nature of experts' risk communication. It does, I hope, inform emerging theories about risk communication and also, I hope, contribute to improving ways that experts communicate scientific information to non-experts. It might also allow them to understand the utility of understanding the wider context of a risk dialogue.

I invite you now to read my dissertation. I hope you find it as interesting as I did to prepare it.

Chapter 2. The literature review.

2.1. Introduction.

The literature review takes a trans-disciplinary approach to the study of risk communication, with the focus on how empirical risks are communicated by experts to non-experts. I consider three domains of literature: the bio-physical sciences, the humanities and the social sciences.

For this inquiry, the term 'bio-physical sciences' refer to the physical and life sciences (Jantsch, 1972), also known as the 'natural sciences' (Beck, 2016 p.112), or 'conventional science' (Driedger et al., 2002). Sometimes, the term 'hard science' is used (Steyaert & Jiggins, 2007 p.584), and there is also the distinction between 'pure' and 'applied science'. Pure science is undertaken in the field, in laboratories and in offices, and applied science involves the application of scientific findings in the material world. Regarding scientific literature, I selected literature about POPs risks to human health. POPs is the acronym for Persistent Organic Pollutants listed under the Stockholm Convention (United Nations Environment Program, 2001)².

The term 'social sciences' refers to the social and behavioural sciences, including sociology, communications and psychology. Social sciences are sometimes referred to as soft sciences, and social scientists study constructs, including for this inquiry, trust, uncertainty, values and risk. For this inquiry, I selected literature about risk construction, risk selection and risk communication, with the emphasis on literature associated with POPs land contamination and remediation.

The social sciences literature shares common research interests with humanities literature, and there is a blurring at the boundaries, reflected today in the acronym HASS, which refers to Humanities, Arts, and Social Sciences.

The humanities literature covers vast domains, and for this inquiry, I allow it to include philosophy, history, and politics. I selected literature with a focus on public health

² POPs are a very large group of pollutants. Those that were first listed on the Stockholm Convention are known as 'first generation POPs', and those listed subsequently, or scheduled for listing are known as 'second generation POPs.' This terminology is used by those familiar with the Convention.

protection, corporate accountability, and public responses to POPs risks. Some related literature known as the environmental humanities was considered.

I begin by exploring the peer-reviewed scientific literature. It is a natural starting point for inquiry into a POPs risk dialogue between experts and non-experts.

2.2. Scientific literature.

This section reviews literature about POPs, their distribution in the environment, and the risks they pose to public health. It looks at peer-reviewed publications and highlights the changing state of POPs risk knowledge over time. The review considers grey literature, including primary sources, produced by international organisations, government agencies and private companies. This literature is not peer-review in the formal sense, but is to a standard of rigour that reflects the knowledge and professionalism of those who created it. Occasionally I will mention NGO literature in order to emphasise a point. Finally, this section considers literature that reflects knowledge contestation about the health risks posed by POPs, including in Australia.

2.2.1. POPs scientific research.

International and Australian studies about POPs include those that described their chemical structure and hazards they pose, identify where residues can be found, why they are there, and the risks they pose to human health.

Early international research explored the transport and fate of POPs in the global environment (Woodwell et al., 1971), including the long distance transport of POPs pesticides (Lee, 1976). At that time in Australia, most research was undertaken in-house by private corporations, including chemical manufacturers and food processing industries. For example, companies that made infant formula tested cow's milk for the presence of POPs insecticides, including DDT and heptachlor, but the results were kept confidential (Short, 1994). International concern about the use of DDT prompted the Australian Government to commission a review about it (Australian Academy of Science, 1972).

There are possible explanations for absence of studies. One might be about the limited technical capacity available for POPs measurement (Birch, 1975; Commoner, 1962). Another might be due to the underestimation of risk due to the incorrect interpretation

of measurements associated with Type 1 and Type 2 errors (Fairweather, 1991), and there is the possibility that lack of POPs risk research was driven by lack of motivation because the task was both new and complex, and there was virtually no dedicated legislative framework (Thompson et al., 1992). Some research was undertaken, for example about sediment contamination (Shaw & Connell, 1982). Lack of risk knowledge did not stop the retail sale of POPs, including for the insecticides DDT, dieldrin and chlordane, all of which were available to the public until the early 1990s (Short, 1994).

From the 1980s onwards, research about POPs increased. The International Maritime Organisation (1987) highlighted risks posed by uncontrolled emissions from incinerators and Wevers (1988) found that emissions to atmosphere were underestimated. Research explored adverse impacts on environmental quality (Nürnberg, 1985) and on public health (IARC., 1987). The Australian Government began an inquiry about Australia's hazardous waste, but was somewhat hamstrung because there was little information upon which to base a policy. When a parliamentary research paper was commissioned to identify documents about POPs waste, very few could be found (Halge, 1985). Public interest in solving Australia's hazardous waste problems prompted the Government to establish a series of bodies tasked with finding solutions (McDonell, 1991; Rae & Brown, 2009), but in other areas, there was secrecy, including about sediment contamination. Two studies were funded by the NSW state Government (Rubinstein & Wicklund, 1991; Wicklund & Finnecy 1987), but with a few exceptions, were confidential to government and industry.³

International and Australian research came of age in the 1990s, with research into global transmission of POPs (Iwata, 1994), ocean pollution from sewerage discharge (Fagan et al., 1992; Mortimer & Connell, 1995), pulp and paper mills (Crossland & Abel, 1992), urban soils (Sund et al., 1993), waste stockpiles (Morrissey et al., 1998; Selinger, 1995), and landfills (ANZECC & NHMRC, 1992; CH2M HILL Pl. , 1997).

³ The NSW State Pollution Control Commission provided access to the two reports to J.K Pollak, a university-based scientist and member of an NGO. The idea was to open negotiation with NGOs about contaminated sediment assessment.

In the 2000s, following the promulgation of the Stockholm Convention, international agreements stimulated more research, including into POPs fate and transport (Lohmann et al., 2007), contamination of sewerage sludge (Clarke & al, 2010; CRC for Water Quality and Treatment, 2007; Litten et al., 2003), discharges from wastewater treatment plants (CRC for Water Quality and Treatment, 2007), and residues in agricultural soils (Holt et al., 2010). POPs are detected in a wide variety of wildlife (Australian Government, 2005; Corell & Muller, 2004; Goerke et al., 2004; Hermanussen et al., 2008; Manning T, 2008).

Pricewaterhouse Coopers Australia (2013) reported on studies that detected brominated flame retardants in a variety of wildlife.⁴

POPs were found in human blood (Staff et al., 2012), breast milk (Harden et al., 2005; Toms, 2007), and in a wide variety of foods (Darnerud et al., 2006; Rauscher-Gabernig et al., 2013), including fish (Corsolini et al., 2005; Domingo & Bocio, 2007).

Risk assessments were made about the potential impacts of residues on human health (Darnerud et al., 2006; Morrissey, 2006; Mozaffarian & Rimm, 2006; Pasquare et al., 2013; Rawn et al., 2013; Rheinberger & Hammitt, 2012; Sidhu, 2003; US EPA, 2001). Consumer durables were found to contain brominated flame retardants (Hites, 2004) and Thomas et al. (2006) demonstrated that people were exposed to them incidentally through daily life, rather than in the workplace. POPs impacts on public health were quantified, with changing assessments as to the extent of the risk made over many years (IARC., 1987; World Health Organisation, 2004).

To this point, we have seen that by the early 2000s, POPs were internationally recognised as ubiquitous global contaminants that posed risks to human health. Although the level of uncertainty about some POPs risks had decreased, the more research was done, the more it revealed what had not been known, and suggested what might come to be known.

The amount of knowledge available about POPs risks today is vast, but agreeing on what it means is another matter, and there is ongoing contestation as to what constitutes an acceptable level of risk, and to whom it might, or should apply, including

⁴ These POPs-based products are used on furnishings, fabrics, in consumer durables like computers, and in everyday products like pizza boxes and paper wrapping for food.

in remediation situations. Sometimes the risk is assessed as acceptable for people, and other times risks level require that action be taken to prevent further exposure (Australian Government, 2005). For example, young children are among the most sensitive receptors since they commonly engage in pica activity, which is the habit of the very young to eat dirt. To address this risk, governments set exposure standards in soils (enHealth Council, 2016; NHMRC, 2002), and when remediation of contaminated soils takes place, those responsible are required to comply with them. However, despite risk management measures like this, there are still problems, as Lanphear et al. (2005) argue, pointing to the lack of assessment of hazardous chemicals, including POPs, for their subtle but serious neurological impacts on children. (p.0206). Australian research also identifies similar health risks (Australian Government, 2005; Connell et al., 2007).

POPs risks to human health have prompted public concern since the 1970s, and the literature points to three areas of contestation.

The first is around the selection of assessment methodology, for example Marquis (1986), Ashford and Miller (1991), Ahlbom (1993) and Driedger et al. (2002).

The second area of contestation is about lack of assessment of chemical mixtures, for example, (C.H.A.S.T., 1990) , Pollak (1993) and Løkke H et al. (2010).

The third area is around data gaps in scientific knowledge about the risks, and it is this area that of particular relevance to this inquiry because lack of risk information can generate distrust in experts. We follow through on the data gap issue in later chapters about uncertainty, empirical risk and trust.

There are huge volumes of industrial chemicals produced every year, and the majority are yet to be assessed for their hazardous properties. Pricewaterhouse Coopers Australia (2013) report that approximately 38,500 chemicals currently listed in Australia lack environmental and human health assessment, and the European Commission (2016) acknowledges that there is limited information about risks, particularly in light of the rate of growth of production of new chemicals (Binetti et al., 2008). Manning (2005) establishes the importance of considering POPs impacts on the endocrine system, and agencies and research groups undertake research to reduce data gaps (CRC CARE, 2014; Hites, 2004; WHO/UNEP, 2013; World Health

Organisation, 2014). Although the extent of impacts remains uncertain, scientists are prepared to state that the evidence, whilst still contestable, is nevertheless strong enough to warrant better targeted research and political action (Ovokeroye et al., 2014; Scheringer et al., 2014).

To complete the review of scientific literature, I introduce two Australian scientists. Their perspective on pollution extended beyond their knowledge domain to the social world where values and ethics are in play. Both men contributed to dialogue about technology risks and took part in political debates about them.

2.2.2. Scientists as people who care.

There are always scientists who, as individuals, work to secure a better future for the world, and Charles Birch was one of them. Birch (1975) questioned the cost of modern technology to global health and well-being, and his condemnation of the use of the POP, DDT illustrates his way of thinking.

“No one dreamed that...most of the DDT sprayed onto crops would get into the atmosphere and thence to the oceans of the world. So a new term has entered the ecological vocabulary – ‘global monitoring’. If we are to alter the physical and chemical and biological composition of the world on such a vast scale, it is time we started measuring these changes...It is as well for us that other members of the animal kingdom often bear the first brunt of our assaults and give us warning that all is not well.” (p.99)

Pollak (1982) is also a scientist who cared. He made a values call when proposing that environmental decision-making about technology be undertaken by a team of moral philosophers, social scientists and scientists. John Pollak argued that this approach can protect the scientific values of intellectual honesty and organised scepticism. He understood the social aspects of environmental decision-making, arguing that the cause of the polarisation between the chemical industry and the public has “in part, been brought about by the chemical and allied industries failure...to either self-regulate or to apply measures which would ensure that environmental degradation and threat to health did not occur” (Pollak, 1987,p.2.). His contribution to science and society is acknowledged in his obituary, which is provided in Figure 2.1. below.

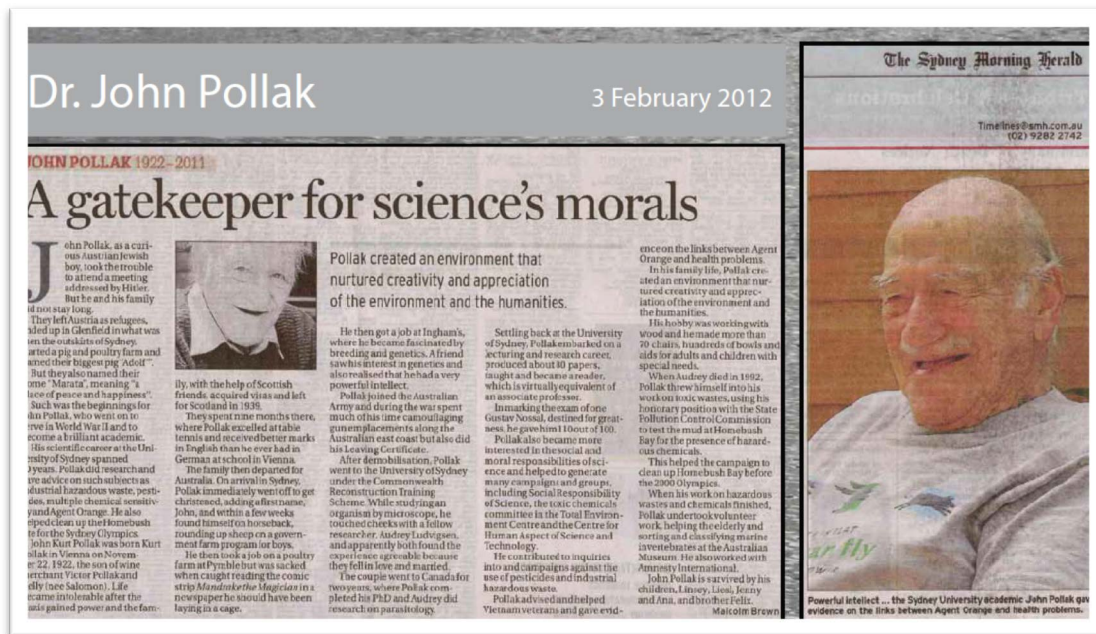


Figure 2.1. Obituary for John Pollak. Source: Sydney Morning Herald, 3 February, 2012. Reproduced with permission of Sydney Morning Herald. 22 November, 2019.

To sum up: This review finds that POPs contamination is a global phenomenon, and that despite years of inquiry, data gaps remain and risk knowledge is continually contested. It finds that scientists can, and do, go beyond their domain of knowledge when a risk situation is such that they feel compelled to do so. In these situations, scientists like Birch (1975) and Pollak (1987), as well as scientifically-literate NGO members use their knowledge and experience as a way to understand the socio-political and psycho-social aspects of the risks posed by a techno-scientific phenomenon. I call this mental state social literacy.

Let's go now and explore the literature about POPs risks created by individual writers and people from NGOs. They are not primarily motivated by scientific principles and truth seeking, but by their moral and political positions associated with this form of pollution risk.

2.3. Humanities literature.

In this section, I review two forms of humanities literature which reflect a shared interest in pollution risks, what they imply for public health and how they can be resolved. Firstly, non-fiction popular literature created by individuals, and secondly non-fiction literature created by NGOs, including primary sources and grey literature.

2.3.1. Non-fiction popular literature created by individuals and institutions.

To make the review manageable, I identified three time periods within which people created text and imagery round inter-related issues and themes. The time periods were selected using two criteria and both concern the emergence of pollution risks, their impacts on human health and their contested status.

See Appendix 2.1. Criteria for selection of time periods.

In the first time period (1961-1978), books were created with iconoclastic themes about the impacts of pollution on society and the environment, including Carson (1963)'s influential book about the systemic loss of biodiversity due to the impact of the POP insecticide, DDT. Her warning of a silent spring initiated global debate about POPs pollution risk (Kroll-Smith & Couch, 1991; Marco et al., 1987). Books were written about the adverse impacts of new chemical technologies. Commoner (1962) described a destructive circle of technology closing in on nature, and Toffler (1972) offered a solution in the form of a technological ombudsman that can cope with society's "future shock", arguing that "we must stop being afraid to exert systematic social control over technology" (p. 398). Goldsmith (1972)'s solution was a blueprint for survival and Meadows et al. (1972) proposed that there are limits to growth, an idea that was, and remains, strongly contested by those who embrace a free market framework around economic issues.

Heilbroner (1972) attributed pollution problems to the excessive influence of private corporations over governments. These ideas were contested by those who failed to see problems arising from human's impact on nature (Efron, 1971, 1984).

Artists expressed concern about industrial technology, creating images to communicate the human cost of unethical behaviour and corporate irresponsibility.

They included imagery depicting the impact of mercury pollution on the residents of Minamata in Japan. Still photographs and a film communicated this situation in emotive and arresting ways, and the name 'Minamata' became synonymous with corporate malpractice and risks to public ill-health (Kuwabara, 2014; Smith, 1972; Tsuchimoto, 1971). The Minamata situation was eventually acknowledged as a clear-cut case of cause-and-effect between mercury and human disease,(United Nations Environment Program, 2013),and it was the same for POPs. It took many years between identification of POPs by chemists and confirmation of their health impacts by toxicologists.

Contestation between experts and the public about the impact of first generation POPs spanned four decades, including debate about the health effects of the POPs herbicide, 2,4,5-T. (Evatt, 1985; International Agency for Research on Cancer, 2012; Ministry of Natural Resources and Environment, 2013; Shepard, 1985). 2,4,5-T and other POPs herbicides were used by the American and Australian military forces during the war in Vietnam ⁵ ⁶. (Vietnam Veterans Federation & Pollak, 1996; Vietnamese Ministry of the Environment, 2011; Young, 2009). Their impact on the health of soldiers and civilians alike caused public outrage in many nations including in Australia (Rogers, 1992; The Australian, 2014). An Australian scientist referred to "mega-death" from chemical agents (Pollak, 1969), and Australian books challenged the morality of chemical warfare in Vietnam (Birch, 1975; Dux & Young, 1980). Others questioned the extent of adverse impacts from 2,4,5-T (Thomas et al., 1986), and the contestation about its risk continued for some years.

In the second time period (1980-1995), public awareness of industrial pollution was heightened by a sequence of catastrophic industrial accidents, including the Seveso explosion in 1976 (European Commission, 2014; Warner M et al., 2011), a near-miss nuclear melt-down at Three Mile Island in 1979, (United States Nuclear Regulatory Commission, 2014), a catastrophic industrial accident in Bhopal in 1984 (Weir, 1986), extensive pollution of the Rhine River in 1986 (Meadows et al., 1972), and a huge oil

⁵ French, American, Australian and New Zealand military groupings conducted a war against North Vietnam and military groups in South Vietnam from 1956 to 1975.

⁶ 2,4,5-T. is listed under the Stockholm Convention. It is a phenoxy-acetic herbicide, used widely for weed control. It was also used in chemical warfare, where it was part of a mixture known as *Agent Orange*. *Agent Orange* also included the herbicide 2,4-D, with aviation fuel used as the carrier.

spill in Alaska in 1989 (Exxon Valdez Oil Spill Trustee Council, undated). These events triggered heightened public awareness about pollution risk in all its forms, including pesticide contamination in poor countries (International Organisation of Consumers' Unions, 1984; Weir, 1986) and dioxin contamination of people and their local environment, including at Love Canal in the U.S.A. (Edelstein, 1988/2004)⁷ The dioxin contamination of the entire Love Canal community brought to global attention the failure of governments to protect public health and led to increased public distrust in their competence and integrity (Mitchell, 1986).

Books were written that illustrated why the public could not trust governments to regulate everyday consumer products (Hillary, 1997; Laura & Ashton, 1991), to understand chemical sensitivity (Ashford & Miller, 1991), to control pesticide use in agriculture and urban pest control (Crumpler, 1994; Frydman, 1997; McHugh, 1996; Short, 1994; Watts, 1994), or to protect the unborn from chemical risks (Smith, 1991). Public concern extended to hazardous product dumping in Australia (Short, 1994)⁸, urban air pollution (Smith, 1990), and fish contamination (Beder, 1989).

One of the most controversial pollution issues of the period, including in Australia, was the health risks associated with the use of 2,4,5-T, one of the two herbicides included in *Agent Orange*. Mothers and others were outraged at the official denial of health problems, including Cook and Kaufman (1982), Van Strum (1983), Elkington (1985) and Williams (1995). Journalists questioned why 2,4,5-T remained available to householders (Dux & Young, 1980), and Robbins (1991) invoked a poisoned harvest. Writers pointed to reasons why the public had reason to distrust multinational corporations, including Van den Bosch (1978) who documented a conspiracy of American commercial interests to weaken pesticide regulation, and Schneider (1983) who exposed a cover-up of fraud and animal cruelty in the IBT testing laboratory in the USA. Writers revealed other corporate malpractice including Adams (1984), Hansson (1989) and Bellini (1986).

⁷ Love Canal was an American community near New York which was built on a former toxic waste dump. The entire community was exposed and many people contracted cancers and other diseases associated with exposure to dioxins.

⁸ The POPs insecticides aldrin and dieldrin were imported into Australia from The Netherlands, and chlordane and heptachlor from the U.S.A. All these compounds had been banned in their place of manufacture at the time they were imported into Australia.

During this second period, films conveyed messages about pollution risk. Documentaries revealed double standards inherent in product dumping (Ritcher, 1983), pesticide impacts on rural communities (Verkerk, 1987) and on children (Williams, 1991). Morton (1997) produced a documentary about the alleged government and industry cover-up of dioxin pollution in a Sydney waterway, and a feature film called 'Silkwood' told the true story of a corporate whistle-blower in the nuclear industry (Nichols, 1983). This film's strong themes and star power created durable public impressions about pollution impacts, corporate power and injustice.

During the third time period (1996-2013), films were made about pollution events, including at Minamata (Saito, 2009) and Bhopal (Kumar, 2013). A feature film called *Erin Brokovitch* gained world-acclaim for telling the true story of a woman who exposed a corporation responsible for groundwater contamination (Soderberg, 2000).

Australians continued to publish books about the Vietnam War, (Brown, 2002; Ham, 2007), and used the internet to promote a digital discourse about pollution. Hay (2011) used the internet to disparage opponents of pollution as coercive utopians who she argued have forced governments to re-assess the scientific basis of chemical safety. She proposed that they created new power relations between themselves and government.

Literature about pollution risks were also generated by NGOs, and we will look at some now.

2.3.2. Non-fiction literature created by NGOs.

During the three time periods, NGOs created textual and image-based content as a conscious act to bring about social change. Their target audience was the public, decision-makers and professionals, and their output included books, reports, conference papers, submissions, declarations, brochures and pamphlets.

During the first period (1961-1978), NGOs emerged as political organisations opposed to pollution risk and advocating for safer industrial technologies. Friends of the Earth (F.O.E.) was formed in 1969, and from its inception, has consistently campaigned against pollution, including pesticide pollution (Friends of the Earth, 1985). This organisation brought together like-minded individuals who connect environmentalism with human rights. The Australian chapter of the Women's International League for

Peace and Freedom (WILPF) ⁹ also made this connection in a pamphlet decrying chemical warfare as a perversion of science. The women called on scientists to take responsibility and contribute to public discussion about the risks that the outputs of their research presented (WILPF, 1969). The world-acclaimed Australian nuclear scientist, Sir Mark Oliphant gave his support to this publication.

The second period (1980-1995) is rich in NGO publications about pollution risks, corporate irresponsibility and the need for policy and legal reform. NGOs in Australia, the USA, the UK and other countries created and distributed knowledge and opinion about pollution issues. Australia's first conference on hazardous chemicals introduced the public, politicians and journalists to hazardous waste issues (Total Environment Centre, 1982). The United Nations Secretariat (1984) issued a declaration opposing hazardous product dumping in poor countries and an international NGO followed through, initiating the Dirty Dozen campaign and stimulating political responses at international, national and local levels (International Organisation of Consumers' Unions, 1984). Political responses to the challenges posed by pollution varied, including within the environmental community.

A report on what to do with Australia's hazardous waste revealed that POPs technology was contested between different environmental groups. Some wanted a single national solution, others wanted hazardous waste streams to be treated by classification, and none wanted a high temperature incinerator. (Toxic and Hazardous Chemicals Committee & Short, 1988).

POPs pesticides were firmly on NGO agendas. Campaigners reported on pesticide-contamination of drinking water (Verkerk, 1987), and Rogers (1992) called for new thresholds for cancer risk assessment. American consumers learnt about pesticides residues in food and became aware about the lack of disclosure of the risk (Mott & Snyder, 1987). Some found risks posed to child health "intolerable" (NRDC, 1989), and the pesticide residue-child cancer risk connection attracted international publicity when actor Meryl Streep became the public face of the anti-pesticide campaign. The campaign brought forward a hotly contested debate about what constitutes an

⁹ WILPF was begun immediately after the 1914-1918 World War by women who were outraged at the human toll of chemical warfare that had been practiced on both sides.

acceptable level of risk to children when they consume every day healthy foods like apples (Negin, 1996).

Dioxin emissions from municipal incinerators and dioxin contamination of land and sediment were made public (Toxic and Hazardous Chemicals Committee, 1986-1997) and the international NGO Greenpeace published reports about risky POPs waste destruction technologies and the commercial drive to adopt them (Greenpeace, 1991). Greenpeace published reports on the risks of breast cancer from POPs (Greenpeace International, 1993), and on POPs manufacturing in Australia (Australia, 1995). The latter report received endorsement from over 20 scientists, reflecting a shared concern between scientists and the public about POPs risks.

At that time, an emerging part of the risk dialogue was the growing human body burden of hazardous chemicals (Toxic Chemicals Committee, 1993), and this new awareness put the limitations of law governing hazardous chemicals under the spotlight (Public Interest Advocacy Centre, 1991). Peoples' legal rights around pesticide risks were explained (Toxic and Hazardous Chemicals Committee, 1992) and Rengam and Snyder (1991) documented how the lack of uniform pesticides exposure standards put people in poorer nations far more at risk than those in wealthier ones.

Access to information about pollution risks gained momentum through the use of film, including a two-part documentary about pesticide and pharmaceutical dumping in poor countries (Ritcher, 1983). A feature film told the real-life story of a scientist who blew the whistle on his employer, a major multinational company (Goldschmidt, 1985).

In the third period (1996-2013), NGOs continue to provide health risk information through reports, but rather than producing them in time-dependent material form, they made them accessible through the internet where they are still available. For example, World Wildlife Fund (2006) website recorded its three-year campaign to raise awareness about the human body burden of POPs and the risks it posed to health. It included a 2005 report 'A Present for Life' which represented these risks as a chain of contamination (World Wildlife Fund UK, 2005).

Greenpeace report on inadequate safeguards against pollution risks, including risks to air quality (Greenpeace European Unit, 2015), and attribute this lack of safety to the influence of private commercial interests (Greenpeace International, 2018). Other

NGO websites, for example Belpomme (2009) and the British Society for Ecological Medicine (2008) provide information about the risks of hazardous chemicals and how to avoid exposure. Gilbert (2012)'s approach is different, in that he accepts that people were at risk from chronic chemical exposure, but rather than building up public anxiety, he frames his risk message to generate a sense of empowerment by encouraging the public to make better choices about which consumer chemical products to buy. Other NGOs prefer a political focus when they direct their efforts towards influencing international jurisdictional agendas, including around the Stockholm Convention's requirements for the safe destruction of POPs wastes. Today, IPEN focus on environmental justice in developing nations (International POPs Elimination Network, 2019)

Whether educative or political in nature, NGOs frame their knowledge around both morality-based and science-based concepts. By doing this, they aim to convey that their knowledge is superior to that created by the chemical industry, or to that created by governments who seek to regulate the activities of this industry. Not only is NGO-generated knowledge positioned as credible scientifically, but also as morality-based information associated with widely-held values that uphold the primacy of the protection of human life.

Visual forms of information communicated a strong message around chemical risk, accountability and morality, including documentary films and television programs. One focussed on the chemical company, Monsanto (Robin, 2010), and others provided information about people's body burden of chemicals, using a narrative style to reveal the chemical industry's dedication to production at the expense of human health (Brown, 2013; Kumar, 2013; Mantel, 2011).

To conclude, non-fiction literature created by individuals and NGOs suggests a form of risk communication, either creating or reinforcing public awareness and outrage about pollution risks and chemical warfare, or arguing that the risks are over-emphasised, or over-stated for political purposes. On balance, the literature reflects anti-corporate, anti-pollution and anti-technology themes, with risks to public health at their heart. This literature draws its credibility through the use of scientific knowledge, and by the ethical concerns it reflects regarding people's rights to an environment where risks of pollution are controlled, regulated and wherever possible, minimised.

Issues identified in this literature include lack of trust, secrecy and recreancy on the part of governments, lack of corporate accountability, lack of transparency within private and public institutions, lack of social inclusion, evidence of increased risks to public health, evidence of conflict of interest and corporate non-compliance with legal requirements, and evidence of chemical warfare and lack of justice for people affected by exposure to POPs.

Overall, the non-fiction literature reveals a conscious effort to translate expert knowledge into a language that lay people can understand and act upon. It provides examples of what the social sciences refer to as contested knowledge and competing values, reflecting concepts such as power, vulnerability, trust, distrust and uncertainty.

In the next section of this review, we consider literature from the social sciences, beginning with the work of two writers whose ideas and insights provide much of the theoretical foundations of modern research into risk communication. It's the right place to start since they are people who are at home in the humanities as well as the social sciences because they are both philosophers and foundation social theorists.

2.4. Two philosophers and foundational thinkers of the social sciences.

The ideas and insights of Luhmann (1979) and Beck (1992) have been front-of-mind for me as I undertook my research journey about experts' capacity for risk communication. Luhmann's idea about time as an event, or time as a state of consciousness allowed me to position past pollution situations and current experiences in a defensible frame of reference. His understanding of trust and distrust as separate social mechanisms with different functions was instrumental to my analysis of social engagement situations about risk.

Beck (1992)'s treatise about the emergence of a risk society is of direct relevance to my inquiry, since the risks he described and explored were pollution risks to human health. He understood the limitations of science in risk assessment and the existence of data gaps, and proposed that the extent of pollution was such that it fundamentally changed how society organised itself. Rather than localised, production-specific pollution risks that most often applied to industrial workers and their local communities,

all members of society had become subject to such risks due to widespread air and water pollution, and food contamination. This situation led to the creation of a new political, economic and social framework and the emergence of what Beck called a risk society.

Let's go now and explore something of their ideas.

2.4.1. Luhmann's way of thinking: The relationships between trust, distrust, competence and confidence.

"Trust is in the broadest sense confidence in one's expectations, is a basic fact of social life...System rationality cannot be attributed to trust alone. It lies rather on a level which includes both trust and distrust" (Luhmann, 1979, p.89)

Niclas Luhmann positions trust as a social mechanism, and he distinguishes two forms. There is social trust (every-day or personal trust), and system trust (confidence). Personal trust is a social relationship associated with private interpersonal interactions and "is only possible in our familiar world ...and subject as such to its own special system of rules" (p.6). When the world becomes more complex and less familiar, another type of trust comes into play. "Trust has to be extended, and the original unquestioning familiarity of the world suppressed...It becomes...a new form of system-trust...This change...corresponds to a change from the bases of trust which are defined primarily in emotional terms to those which are primarily presentational" (p.22). So what does Luhmann mean by presentational? It is when "conditions of increasing social complexity (require that) man can and must develop more effective ways of reducing complexity" (p.7). Regarding "more effective ways", Luhmann gives the primary role to confidence. When situations become more complex and have internal requirements around stability, confidence rather than trust becomes dominant. Here, Luhmann proposes a critical role for experts. It is the application of their knowledge that allows "sufficient controls over reliability in the system and on the fact that these controls function independently of the structure of personal motives of any of the participants" (pp.52-53).

Luhmann's way of thinking informed subsequent studies of trust and confidence (Siegrist et al., 2005), and resonates with my inquiry about the experts' capacity to explain empirical risk. As we find in subsequent chapters, experts are required to

provide for the stability of a remediation system. Whilst it is important that they be trusted by others to deliver a safe and effective remediation process, more important is that they are competent to do so. Again, Luhmann's insights are helpful. He proposes that competence is about controls that "must be built into the systems which require trust and those controls must be made quite explicit, established as professionally and tested truth" (p.57).

Here we move to the next key feature of Luhmann's way of thinking - the distinction he makes between trust and distrust on the grounds of their functionality. In his schema, trust and distrust are not the opposite ends of a spectrum, with blind trust at one end and abject distrust at the other. Distrust is not just the "opposite of trust...it is also a functional equivalent for trust" (p.71). He proposes that they co-exist within the same situation, with each exerting dominance at different times, depending on the circumstances. He writes:

"System rationality...(requires that) trust and distrust...(exist) alongside one another..... The trust in systems ...depends decisively on trust being curtailed at critical points and distrust being switched on...Systems are rational to the extent that they encompass and reduce complexity" . (Luhmann, 1979 ,p.89-92)

Throughout this dissertation, I will be drawing on Luhmann's thinking, and also on that of the other founding risk theorist, Ulrich Beck.

2.4.2. Beck's way of thinking: Pollution as a hazard and the social construction of risk.

"They are the stowaways of normal consumption. They travel on the wind and in the water. They can be in anything and everything...destruction steals in everywhere implicitly and unhindered by free (!) decisions" Beck (1992 p. 42.).

Beck (1992) proposes that people in industrial societies have developed a heightened consciousness of risk due to "the horrific panorama of a self-endangering civilization" (p.23), a situation had never before been experienced by people. He proposed that the "horrific panorama" was the result of industrial processes that create toxic chemical and nuclear pollution. As distinct from "the old hazards...excrement, putrescence everywhere perceptible to the senses...the new hazards are fundamentally different

in that they can be dissociated from a known place, pollute entire regions (and) pose irreversible threats to life in all its forms. They typically escape perception” (Beck, 1992 p.21).

Beck identified hazards. There were “toxins in the air, the water, the soil, food, furniture (p. 67), “toxins in foodstuffs” (p. 21), “in breast milk” (p. 25) and “in refuse dumps” (p. 200). He understood that pollution is a mix of toxins, and that not all toxins could be measured: “Entire families of toxins do not even appear. The continuation of the list of pollutants is limping hopelessly behind the production and use of chemical substances” (p.66). He asks who can explain what the total burden of pollution means in terms of human health, but hears only “voids of silence” and disparages “the architects of acceptable values”. He questions how they can “set values for individual toxins” when people “are collecting vessels for all sorts of pollutants...Whoever would determine threshold values of toleration must take account of this...Those who nonetheless set acceptable levels for individual toxic substances... completely miss the opportunity to speak of acceptable values for people” (p.67).

Here Beck identifies the tension between scientific and social values, and argues that “society is (a) permanent large-scale experiment...with a reversed and elevated burden of proof” (p.69). He identifies those who are conducting the experiment as “the experts sitting there with their deeply furrowed brows” (p.69) monopolising scientific knowledge claims and delivering “so-called ‘neutral’ figures, information or explanations which are to serve as the unbiased basis for decisions”. Beck argues that these are not neutral decisions (p.174), and in this way positions empirical risk as a social construct with variable meaning. It is a critical aspect of his thinking that makes a distinction between those who create the hazards which give rise to the risks, and those who are obliged to take the risk. In this way, risks are politically determined and as a result, contested. He conceives of a “division of the world between experts and non-experts, (between) the technological elite (and) the majority of people” (p.58).

The division about the meaning of risk might remain unresolved, but in Beck’s schema, it can be potentially transformational for society in a positive way if both scientists and the public practice reflexivity. The public can mobilise politically against industrial pollution risks, and scientists, as experts can practice it when they break with “overspecialized science... ..and embrace an alternative theory of cognition” (pp. 179-

180). Here Beck positions experts as people who can make a difference if they play a part in this renewal process. He considers how they would do this as a “completely unwritten page” (p. 235). More than thirty years have passed since Beck published “Risk Society” (in 1986 in German) , and much research has been undertaken since he conceived the idea. However, the point that Beck made about POPs pollution of the environment and its impact on people remains extant, and as the scientific literature has shown, the risks it poses have increased to an alarming level. My inquiry might help fill some gaps on what was one that “completely unwritten page that page” if it generates defensible findings.

I’ll leave discussion of Beck’s work now but, as with Luhmann, will draw on his thinking throughout this dissertation. Let’s go now and consider literature about risk and risk communication found within the social sciences.

2.5. Social Science Literature: Theory, models and frameworks.

“Risk communication is a dynamic field, both an art and increasingly a science, and a great deal more theoretical and empirical work is required before our comfort level increases.” M. R. Greenberg et al. (2012 p.777).

Social theorists have researched risk communication between experts and non-experts, for example Leiss (1996), Kasperson et al. (1998), Gurabardhi et al. (2004), Bickerstaff (2004), Gregory et al. (2006) and Flynn and Bellaby (2007).

They propose that different epistemic communities create risk knowledge on their own terms, and argue that this is the reason why risk communication between experts and non-experts can fail. Researchers investigate the failure of communication by exploring contested knowledge forms and the production of meaning. Key areas of research include social engagement, agency, legitimacy, values, trust, uncertainty and perception. Trust is a major focus of risk research, including by Cvetkovich and Earle (1992), Cvetkovich et al. (2002), Keller et al. (2006), Earle et al. (2007) and Siegrist et al. (2007). There are different approaches to measuring trust, for example White and Eiser (2007) propose determinants and Naef and Schupp (2009) refer to measures. Trust is variously defined, with Petts (2008) pointing to sixteen definitions. Sometimes

distrust is a subject of research (Groothius & Miller, 1997; Trettin & Musham, 2000), as is the influence of mass and social media on levels of public trust (Bryant & Oliver, 2009; Macnamara, 2014; Scheufele & Tekesbury, 2007; Witthoft & Rubin, 2013).

Risk researchers explore values, for example, Cross (1998) and Gregory et al. (2001), and investigate uncertainty, for example Tversky and Kahneman (1974), Aven (2007) and Boholm (2008). Aven discusses risk setting in the face of uncertainty, proposing that those charged with setting a risk level need to understand two ethical states: the ethics of the mind where morality is in play, and the ethics of consequences when utility is dominant. He argues that there is a tension between them and, if not enough is known about a risk, values function as a mediator between different epistemic communities. However, relying solely on values to determine a risk is not sufficient, and requires as well, trust in experts' knowledge. In this sense, trust is an act, a form of behaviour. It involves the action of placing trust, and this can take time.

Researchers propose theories of risk communication based on epistemic positions that range from strongly realist, through to critical realist and strongly constructivist (Botterill & Mazur, 2004; Flynn & Bellaby, 2007; Moon & Blackman, 2014). Those within the realist school tend to emphasise scientific knowledge, constructionists prefer engagement and interaction, and somewhere in-between are those interested in the individual's perception and experience. There are variations within theories and their borders are not always rigidly defined (Irwin, 2007). This blurring at the edges is evident in what researchers refer to as a spectrum of activity which allows epistemic settings that accommodate different models of risk communication, including 'informing', 'involving' and 'collaborating'. For example see CRC CARE (2019a) and Cundy et al. (2015).

Let's go now consider the three overarching models of risk communication identified in the literature: the deficit model, the dialogue model and the mental model.

2.5.1. Deficit models of risk communication.

“The public...only need to be stuffed full of technical details, and then they will be able to share the experts’ viewpoints and assessment of the technical manageability of risks, and thus their lack of risk. Protests, fears, criticism, or resistance in the public sphere are a *pure problem of information*” Beck (1992 p.58. Original emphasis).

Deficit models are positioned at the realist end of the epistemic spectrum (Irwin, 2007; Vandermoere, 2008), and are known colloquially as the ‘decide and defend’ or ‘hard science’ models. Variations include risk message and risk dialogue models (Wardman, 2008), or the realist or foundationalist approach (Flynn & Bellaby, 2007; Vandermoere, 2008). Examples of a deficit model approach include texts by Franke and Franke (1975), Nürnberg (1985), The Royal Society (1986) and Wallace (2011).

Deficit models propose that the communication of scientific knowledge can resolve conflict around risk selection. They place scientists (experts) at the centre of a risk dialogue, and presume that they are trustworthy and competent. In this schema, the role of the expert is to reduce non-experts’ knowledge deficit about involuntary risks so that there is less conflict about them, which can delay or prevent their acceptance.¹⁰ Deficit models preference scientific knowledge over all other knowledge forms, including tacit, cultural or local knowledge and are defended on the grounds that scientific knowledge is the only knowledge form that can explain the meaning of empirical risk.

As Owens (2000) explains it, deficit models voice “the lament...that lay people are ignorant of environmental science and irrational in their response to risks...the public must be engaged in order to be better informed and converted to a ‘more objective’ view” (p.1141). When a deficit model is in play, non-experts can ask questions about scientific issues, but not question the integrity or veracity of the science itself. (Leiss, 1996; National Academies of Science, 2017; Ropeik, 2011).

Research about improving deficit models focuses on making science content both more understandable and more accessible. Contemporary versions provide scientists

¹⁰ A voluntary risk involves tobacco smoking which a person does by choice. An involuntary risk is something a person cannot avoid such as exposure to pollution from industrial emissions.

with approaches and techniques that can improve their communication with the public, involving, for example, techniques to improve content delivery, and approaches that support more inclusive engagement processes, as well as encouraging attention to the values and expectations of lay people (M. Greenberg et al., 2012; National Academies of Science, 2017; Ropeik, 2011). Contemporary thinking within the science communication community reflects this approach, and today's science communicators aim to enhance public confidence in science and its achievements. (Australian Science Communicators, 2019).

Deficit models are based on the assumption that a particular risk is scientifically defensible, always manageable and therefore socially acceptable, provided that people are provided with enough information. What is missing is consideration of competing values and other knowledge forms. If people have firmly held values, for example about health protection, then they might reject what is scientifically considered an acceptable risk for reasons other than its empirical characteristics.

Poortinga and Pidgeon (2003) find that individuals cannot always be persuaded by expert knowledge, and that if scientific information is over-emphasised, people might conclude that their concerns are not being taken seriously. Similarly, Gregory et al. (2001) propose that when people hold rigid philosophical positions about technological development and oppose it, those who deploy a deficit model approach to communicate with them will probably fail, even if the empirical risk is insignificant. In this respect, criticism of deficit models are based on what facts are selected, and why they are selected. As Fischhoff (1998) explains: "it is hard to know why particular facts were chosen for risk communications... Commonly known facts may be repeated, while potentially useful ones are presented without necessary context" (Fischhoff, 1998 p. 66). Owens (2000) offers an explanation by pointing to the influence of the power relations inherent in the deficit model. She argues that those who adopt it are motivated by the need to legitimate a decision that has already been made and that "the aim is passivity" (p.1141). Scheer et al. (2014) might agree since they identify a *control* problem around knowledge selection, whereby those with responsibility for selecting a risk level decide the level of risk acceptability and extent of liability. In this schema, experts might, as Trettin and Musham (2000) propose, lack the motivation to explain the actual level of risk due to self-interest.

Another criticism is around a recognition that risk knowledge is processed differently by competing epistemic groups. Bergmans (2008) for example, rejects any approach that interprets risk as a statistical 'fact', and proposes that "treating differences in risk perception as a rationality deficit between 'true' and 'perceived' risk, is not adding value" (p.180) Here, the meaning of a risk is framed around competing interests rather than scientific facts.

These perspectives suggest that deficit models, no matter how well applied in a given situation, may undermine public confidence in science and trust in scientists. So can deficit models be improved or should they be abandoned? Gregory et al. (2006 p.397) reject their basic premise about the need "to retrain the lay public", preferring "more deliberative methods that can cope with the principles of sustainability and the limits of expert knowledge".

Now whilst there are legitimate grounds for criticism of deficit models, they can be too rigidly characterised. Even early proponents understand something of the psycho-social and socio-political context of technology risks, for example when the concept of 'community right to know' was mandated in amendments to Superfund laws ¹¹(United States Government, 1986). Today, institutions opt for improved versions of deficit models around social inclusiveness (National Academies of Science Engineering and Medicine, 2017), but whether values-based add-ons actually work is questionable (Benn et al., 2009).

Brown (2009) proposes a new way to 'fix' the information deficit, this time in reverse. He argues that the information deficit belongs to the expert who has to "live with, and manage, uncertainty and lack of knowledge" (p.609). In his schema, endless scientific research into uncertainties leads to weak decision making, and rather than continue to allow "paralysis by analysis" (p. 609), he wants attention to decision-making that is inclusive, supports knowledge transparency, considers ethics and values, and facilitates protective action in the face of ongoing uncertainty (pp. 610-611). Brown is not alone in this way of thinking. Van Asselt and Vos (2008)'s uncertainty paradox aligns here since it allows for scientific uncertainty to co-exist in a risk situation that provides certainty. As they explain it, the uncertainty paradox is "an umbrella term for

¹¹ The US Government created the Superfund law to manage the identification, assessment and management of thousands of contaminated sites spread throughout the USA.

situations in which uncertainty is acknowledged, but the role of science is framed as one of providing certainty” (p.281). I will refer to the “uncertainty paradox” throughout this dissertation, and all future reference to it will be without parenthesis.

To conclude, the literature suggests that deficit models have useful features. However, even if made more ‘user-friendly’, they remain inadequate because they position the technology that brings the risk into play as a *fait accompli*, and assume that because it is manageable, it is therefore acceptable.

Let’s go now and consider dialogue models which frame expert knowledge in its socio-political context.

2.5.2. Dialogue models of risk communication.

“We have (found) a diverse group of citizens (to be) remarkably open-minded about risk issues, once allowed to express themselves in their own terms.”
Fischhoff (1998 p. 65).

Dialogue models emerged as a response to the shortcomings of deficit models. Evans and Plows (2007) allow that they can “improve the scrutiny and accountability of science (providing) a positive role for non-expert citizens in the democratic control and oversight of science” (p.827)

In the broadest sense, dialogue models preference risk dialogue over risk content, and assume that a consciously democratic process can deliver a desired outcome because dialogue models prioritise two-way engagement between experts and non-experts, for example, as proposed by Susskind and Field (1996) and Gregory et al. (2006) .

The models champion the right to interrogate the knowledge that underpins risk assessment, and the right to know what level of competence is on offer to manage risks. In this way, dialogue models involve more than asking questions about a technology risk, as is the case with deficit models.

Dialogue models accept that there is a social and political context associated with risk knowledge. As Reed et al. (2014) allow, knowledge is “context- dependent and strongly related to an individual’s perceptions and world-view” (p.342). They associate stakeholder engagement with the term ‘represent’, and frame knowledge exchange

within a set of five principles (pp.340-341). Kiker et al. (2005) emphasise contemporary values and position them around social inclusion as a way to facilitate knowledge transparency, the exchange of ideas and experience, and understanding and reflection. Researchers also allow that values are reflected in situations where there is an emphasis on fair process and consensus, and an acceptance of knowledge contestation around risk selection (Gallagher & Jackson, 2008; Roelofsen et al., 2011; UNDP). Hitlin and Piliavin (2004) comment on the uncertain place of values as a construct in sociological research, and Zsolnia (2003) addresses competing value preferences (p.288). Overall, researchers allow that consideration of conflicting values is essential to achieve a balance of power between experts and non-experts during social engagement

There are various iterations of the dialogue model, including the risk dialogue model, the interactive understanding model, the deliberative model, the rights-based approach and the cultural approach. Researchers that propose them include Wynne (1988), Irwin (2007), Álvarez-Farizo et al. (2009), Cox and Lowrie (2015) and Taylor-Gooby and Zin (2006).

So where is knowledge positioned in dialogue models? It is 'knowledges', not 'knowledge' that apply, with epistemological tension around contested knowledge always in play. Fischhoff (1998) understands this as the key feature of dialogue models, proposing that "if analytical processes supplant participatory ones...scientific knowledge can function as "a tool of disenfranchisement" (p.65). What is required is the mutual sharing of knowledge through reflective discourse, or as the United Nations Development Program position it, the non-expert's role is to 'speak truth to power', and thereby engage in a form of "participatory governance (that) ...focuses on...increasing opportunities for citizen voice". (UNDP, p. 8.)

The question is 'what truth and whose power?' How much power can non-experts really have? Researchers can be sceptical about the assumptions inherent in dialogue models. For example, Slovic (1998) defines risk as "an exercise in power" (p.76), and Irwin (2007) argues that organised interest groups, elites and professional experts are "the main institutional actors who make choices among technologies" (p.3). Similarly, Bessette et al. (2017) find that economic values are prioritised at the expense of those around environmental health or culture, which "are often ignored" (p.1193), and Spash

(1997) finds that people who hold “rights-based beliefs about significant environmental issues” may be excluded from public dialogue” (p. 403).

So where do non-experts fit in? In this regard, a critical aspect of dialogue models is their assumed capacity to accommodate what can be uncomfortable discussions around the transparency, legitimacy and uncertainty of scientific knowledge.

To this point, we can see the advantages of dialogue models with their democratic aspirations. Now let’s turn to their limitations. They include, first and foremost, when a technology is rejected on principle, and cannot be negotiated. Pidgeon et al. (2007) propose that when individuals hold strong preconceived beliefs, nothing will change their position on a technology they oppose. Renn (1998) is aware of this conundrum when he asks “who can legitimately claim the right to select the values or preferences that should guide collective decision-making, in particular when health and the lives of humans are at stake?”(p.56) Scheer et al. (2014)’s construct of the *strategic problem* is in play here. It points to the role of “special interests” in the risk selection process, including those represented in governments, the commercial business world, and the NGO sector (p.12).

Gregory et al. (2006)’s solution is recourse to institutional change that supports well-structured and open discourse as a way to reconcile values and rational decision-making. They propose “a procedural model of responsible decision making” (p.49). Pollard et al. (2004) also default to an institutional remedy, however, in their case, they fail to clarify how to include competing values in decision-making (p.23.) Fontaine (2008) offers practical advice by identifying techniques that support public participation, including the creation of “a project narrative that gives context” and allows people to “relate it to their daily lives” (p.233).

Reed et al. (2009) propose typologies of participation (Table 1, p.1937), including open space forums, roundtables, negotiated rule-making exercises, mediation, or advisory committees that include scientists and stakeholders. Again, these are familiar remedies around the overarching principles of ‘inclusion’ and ‘participation’, so the question is, what happens in these settings? Once seated at the table, how do people participate? They might, as Stoffle and Minnis (2008) explain, use vernacular forms of speech which, whilst possibly needing translation, do have intrinsic value. This brings to mind the idea of fair process.

Fair process involves two-way communication (Fischhoff, 1998), representation, collaborative framing and connection between process and outcome (Petts, 2008). The advantage offered here is around active relationships that allow for thoughtful questioning and scepticism by the public, and foster critical, as opposed to general or social trust (Petts, 2008 p.832). So how does inclusion work? How are people empowered to participate? Petts proposes that experts can create roles where people act as “gatekeepers of knowledge, concerns and values” (p.826) and thereby allow experiential knowledge to be considered. Fontaine (2008)’s version is that of an “independent credible champion” whose role is to facilitate legitimate contestation about a risk situation and risk selection. Such a champion needs to be “trustworthy, able to communicate and have strong ties to the community” (p.223).

Other research questions the assumption that dialogue models deliver satisfactory outcomes for all interested parties. Hillier et al. (2009) find that “wide access to public processes is no guarantee of substantive equity where resources are inequitably distributed amongst participating stakeholders” (p.1606). Benn et al. (2009) argue that an equitable process can lead to a perverse outcome by legitimising a decision-making process that provides support for risky technology. Owens (2000) is similarly sceptical, arguing that even improved dialogue models could be “just as much about legitimation as the ones they seek to replace”, and is wary of participation that is “discursive, detached and consensus-dependent” (p.1145)

Gurabardhi et al. (2004) find that too much emphasis on psycho-social aspects of discourse can allow participants to lose sight of their main objectives, and Gregory et al. (2001) point to the tendency of dialogue models to expand an agenda to the point where it becomes unwieldy. Irwin (2007) cites evidence that found that more debate generated more issues, and that open-ended dialogue did not necessarily ‘fix’ the trust problem (p.34). Similarly, Healy (2009) finds that more talk does not equal better outcomes and paradoxically, could lessen the participatory power of non-experts rather than increase it. In an odd twist, he finds that unlimited dialogue is more likely to be associated with deficit, rather than dialogue models because community participation does not automatically imply equality of agency. In this sense, if non-experts are out of their depth because the information provided to them is too complex, their input to a process might be marginalised.

Owens (2000) suggests processes that are “practical, committed and ready for conflict” are more effective (pp. 1145-1146). She finds that such processes would allow for expertise, (“practical”), aim for outcomes, (“committed”) and incorporate distrust into the mix (“ready for conflict”). However, Owens fails to explain what this would involve or how it could be done, probably because for her, “the signposts remain confused, because the destination is not only distant but involves a greater challenge to the status quo than has hitherto been acknowledged” (p.1147). One solution to Owen’s problem might be a change in focus. Irwin (2007), Vandermoere (2008) and McDonell (1991) point to the neglect of opportunities that support discussion about benefit as well as risk, and the resultant failure to focus on mutually-agreed upon outcomes. Vandermoere (2008) finds that deliberative methods of social engagement can be effective if they bring forward discussion of benefit, and criticises strong constructionist versions of the dialogue model around their positioning of dialogue as the reason for a social engagement process, rather than as a way to achieve a mutually agreed outcome. Pezzullo (2007)’s focus on toxic tours¹² exemplifies this problem. In her schema, engagement involves interaction between black people from working-class communities who have experienced environmental injustice due to pollution, and middle-class white people who want to support these people through a process of dialogue. The dialogue is about ill-health and the need for environmental justice but Pezzullo (2007) defaults to a legal remedy by way of recourse to the courts. She makes no mention of technical processes that could rehabilitate a damaged environment and scant mention of the need to share information.

At this point, we can appreciate that acknowledgement of power relations and agency is a key characteristic of dialogue models, and that too much emphasis on process and not enough on content (knowledge) can be a limitation. In this sense, dialogue models might not be entirely fit for purpose when contamination risks and remediation remedies are both in play. Whether they are or not is considered in Chapter Eight, but at this point, it is useful to note that international agencies, national and state governments, academic and private institutions tend to rely upon dialogue models when issuing formal guidance. (Sustainable Remediation Forum, 2011). Australian iterations include a handbook for professionals (Heath et al., 2010), and the National

¹² “Toxic Tours” refers to organised bus tours of contaminated sites in Louisiana’s Cancer Alley.

Environment Protection Council (2013)'s National Environment Protection Measure (NEPM). Whilst both guidance documents allow for public inclusion and dialogue, they avoid the issue of resolving contested knowledge forms and values, focussing on process rather than the purpose of the process. Whilst they do address the way individuals think about, and respond to risk situations, it is not intrinsic to the design of social engagement processes that they propose.

At this point, we can consider the third model of risk communication which does just that.

2.5.3. Mental models of risk communication.

Mental models focus on how individuals process risk knowledge. They lie within the domain of psychology and “are personal, internal representations of external reality that people use to interact with the world around them.” Jones et al. (2011 p.1)

Mental models provide reasons as to how and why individuals and different epistemic communities select and negotiate their particular version of risk. Put simply, mental models provide explanations for individual or group responses to potentially risky situation, and address why an emotional way of thinking tends to crowd out more analytically-based responses to risk.

Scholars have arrived at a broad consensus about the central place of mental models in risk communication. As Botterill and Mazur (2004) propose, they legitimise contestation in a risk dialogue because they accommodate all forms of knowledge, and allow for perceived as well as empirical risk.

The advantage offered by mental models is that they allow for two modes of thinking, one being the analytic mode, the other the experiential mode (Slovic et al., 2004). The analytic mode “uses algorithms and normative rules such as probability calculus, formal logic and risk assessment and is relatively slow, effortful, and requires conscious control”. The experiential mode “is intuitive, fast, mostly automatic, and not very accessible to conscious awareness” (p.311). It governs how people perceive phenomena, particularly potentially threatening ones. It is “the most natural and common way to respond to risk. It relies on images and associations, linked by

experience to emotion and affect (a feeling that something is good or bad)” (Slovic et al., 2004 Table 1., p. 313).

M. Greenberg et al. (2012) position the two modes as operating in parallel, with “fast, intuitive, and emotional response anchor(ing) initial evaluations of risky prospects, which slower cognitive pathways may then adjust” (p.772). Similarly, when decision-making about a risk is required, Morgan et al. (2002) require that both analytical and experiential modes of thinking be in play so that decisions regarding the management of management of risk are guided by both reason and emotion. When there is unresolved tension between modes, there is a mismatch between empirical and perceived risk and as a result, risk communication tends to fail.

The contribution of psychology to risk research is not new. M. Greenberg et al. (2012) acknowledge this when they review 30 years of risk literature, finding that “about half of the 20 most cited articles...are the product of the contribution of psychologists” (p.772). Central to mental models is the function of psychological processes known as heuristics. Described as mental short-cuts, heuristics are the immediate, intuitive responses of a person to an external stimulus (Boholm, 2008; Finucane et al., 2000). As subconscious tools that process information, researchers propose that heuristics are more influential on an individual’s perception of a risk than conscious thinking and cognition, for example Mitchell (1992), Slovic et al. (2004), Finucane et al. (2000), Ropeik (2011) and Gupta et al. (2012).

Slovic et al. (2004)’s reference to the work of the neurologist Damasio (1994) is instructive. As they explain it, Damasio proposes that “rationality is not only the product of the analytical mind, but of the experiential mind as well” (Slovic et al., 2004 p. 321). Finucane et al. (2000) refer to Damasio’s idea that thought is made largely from images, broadly construed to include perceptual and symbolic representations. Slovic et al. (2004) expand this idea, explaining that “(t)he *experiential system* encodes reality in images, metaphors, and narratives to which affective feelings have become attached” (p.316, original italics)

The role of imagery in risk perception was established in an experiment by Visschers et al. (2008). They find that imagery, as presented through a video affected the experiential process of a perceived risk, whilst a text affected the analytical process and the risk message. This experiment demonstrated the unique position of imagery

in affective, as opposed to rational responses to a risk, and points to the tension between fact and feeling that can influence the quality of risk communication. Visschers and Siegrist (2008) find that an external stimulus such as a risky technology can elicit a range of heuristics, including the affect heuristic which allows an individual to draw on memory and experience, and upon their own pool of positive and negative experiences. (p.158) It is worth noting that M. Greenberg et al. (2012) ranked the affect heuristic as first among ten major accomplishments of risk analysis. Its importance lies in the idea of thinking fast as opposed to thinking slow, a schema made popular by (Kahneman, 2011)

In this inquiry, toxic substances like POPs are in play, and it is mental models of risk communication that offer plausible reasons as to why people have conflicting perceptions about the risks they pose to health. For example, Ropeik (2011) finds that people initially react instinctively to poisons through the senses or through memory, and when presented with a risk situation, interpret empirical risk knowledge using “affective, emotional, and instinctive psychologic cues” , regardless of scientific evidence. Because of this natural response, “evidence...will have to compete with, even as it informs, how people feel about risk.” (p.1) Ropeik stresses the need for experts to understand that the subconscious processing of information is more influential on risk perception than conscious processing using cognition.

Renn (2006) allows that when responding to risk, all do so “according to their own risk constructs and images (p.31). Each individual’s risk perception combines common sense, reasoning, personal experience, social communication and cultural traditions. In this schema, it is all about how each individual contextualises a risk. Renn proposes that context is “particularly relevant when individuals face a decision that involves a difficult trade-off between attributes or where there is interpretative ambiguity as to what constitutes a ‘right’ answer.” (p.33) When faced “with an eminent threat, humans react with four basic strategies: *flight*, *fight*, *play dead* and, if appropriate, *experimentation* (on the basis of trial and error).” (p.31)

At this point, we understand that in mental models, the perception of risk relies initially upon heuristic responses. Two books have shown heuristics in play in communities impacted by contamination risks. Edelstein (1988/2004) alludes to heuristics when he documents how people’s emotional response is based on their memory of long-past

injustice associated with the American civil war. Pezzullo (2007)'s toxic tours rely upon the existence of heuristic responses to pollution, including fear and anxiety. She positions these emotions as a part of a political tactic to address corporate power and lack of accountability for exposure to pollution. In her schema, toxic tours represent "the democratic tactic of resistance" (p.102) that enables "a negotiation of power" (p.8).

Gallagher and Jackson (2008) identify a role for heuristics in the design of a social engagement process associated with contaminated site clean-up. They find that when heuristics are recognised, a more successful outcome is likely because people feel that they are being treated fairly and with respect. Similarly, Petts (2008) finds that when experts take time to listen to people in their homes, they can generate a positive emotional response in them, including feelings of trust in the expert.

Overall, mental models aim to explain why conflict arises during a risk dialogue. They have limitations, including a tendency to overemphasise the individual, focus too much on risk perception, and underestimate the influence of external issues, particularly power relations and agency (Gregory et al., 2001). As Owens (2000) finds, mental models "say little about the mechanisms controlling collective and structured environmental behaviour and the potential for changing it." (p.1143)

See Appendix 2.2. Social Science Literature: Theories, models and frameworks.

At this point, we can leave discussion of the three overarching models of risk communication and explore two frameworks that offer ways to conceptualise the relationship between empirical and perceived risk.

2.5.4. Two useful frameworks.

The research literature identifies two frameworks. One is the Social Amplification of Risk Framework, envisioned by R. E. Kasperson (1986), proposed by Kasperson et al. (1998) and further developed by Renn et al. (1992). The other is the Trust, Confidence and Cooperation Model, as proposed by Earle et al. (2007). Hereafter I will refer to the former as SARF, and the latter as TCCM.

SARF accounts for the amplification of risk by identifying a sequence of factors that contribute to what is termed "a risk event". Amplification is associated with social, political, and psychological responses to that event. Gregory et al. (2006) describe

the amplification process as starting "with either a physical event ...or the recognition of an adverse effect In both cases, individuals or groups select specific characteristics of these events or aspects of the research findings, and interprets them according to their perception and mental schemes." (p.140).

SARF accounts for all "information processes, institutional structure, social group behaviour, and individual responses (which) shape the social experience of risk, thereby contributing to risk consequences" (Kasperson et al., 1998 p.181). With respect to social and political responses to risk, SARF allows for factors around the construction, ownership and distribution of risk knowledge, social conditions, and individual situations. With respect to psychological responses to risk, SARF allows for personal experience, individual senses and what they call "intuitive heuristics". As for risk consequences, they first appear as "ripples", effecting individuals as well as commercial, legal and administrative situations, and then extend to become impacts including financial losses, regulatory constraints, loss of confidence in institutions, and increase or decrease in physical risk.(Kasperson et al., 1998). The SARF network diagram is provided below in Figure 2.2.¹³

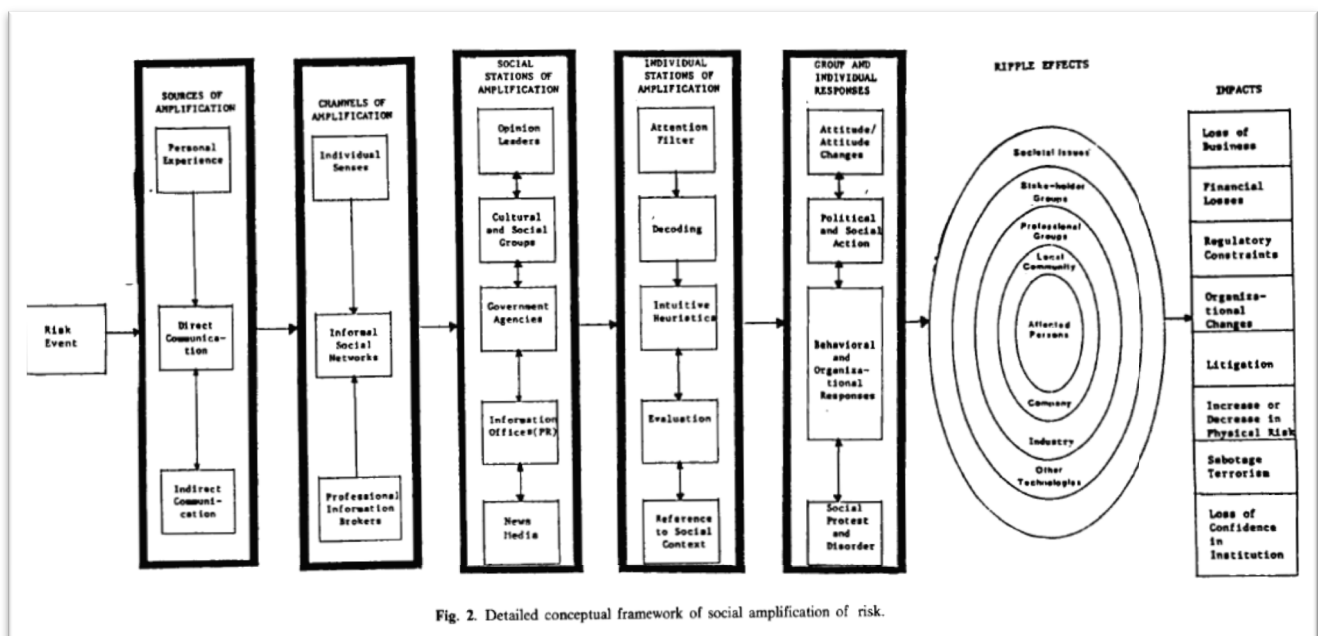


Fig. 2. Detailed conceptual framework of social amplification of risk.

Figure 2.2. Representation of the Social Amplification of Risk Framework. Kasperson et al. (1998, Fig. 2., p. 183)

¹³ The text within this network diagram is very small in the original article, and it is reproduced in its original form here.

Limitations of SARF include the dominant positioning of risk as a negative. Only one benefit is identified in the form a decrease in physical risk. From a historical perspective, it is understandable that SARF aligns risk with negativity. Risk events that occur during, or prior to the year in which it was developed include major globally-recognised events, including those that occurred at Bhopal in India, Love Canal in the USA, and Seveso in Italy. R. E. Kasperson (1986) specifically refers to them ¹⁴, as do Bohnenblust and Slovic (1998), who propose that such catastrophic accidents create signals because of their consequences.

It can hardly be claimed that any benefit came from these catastrophes in the short term, but over the long-term, they functioned as a catalyst for reforms in the chemical manufacturing industries in many countries, including in pollution monitoring and control, and the implementation of more protective frameworks. These include international conventions such as the Stockholm Convention (UNEP, 2002b), and accompanying technical support programs (Fiedler, 2007).

The second useful framework is a mental model that owes much to the thinking of Luhmann (1979). Known as TCCM (Earle et al., 2007), it focuses exclusively on psychological processes, differentiates between confidence and trust, and allows for interaction between them. The authors nominate it as a model rather than a framework, but for the purposes of this discussion, the distinction between a framework and a model is not critical.

TCCM is based on psychometric measures that build cooperation around analytical and emotional processes associated with a dynamic relationship between trust and confidence. A group of researchers have progressively developed this model, including Cvetkovich et al. (2002), Siegrist et al. (2005), Earle and Siegrist (2006), Siegrist et al. (2007) and Earle and Siegrist (2008).

Earle and Siegrist (2006) propose that TCCM provide “a more unified understanding of the primary pathways to cooperation” (p. 410), since if decision-makers utilise it, they can distinguish between trust and confidence. They connect values with the

¹⁴ Chapter Four makes findings about the social significance of these and other events using results from the Milestone Questionnaire.

generation of social trust (experiential) and professional performance with confidence (analytical) (p.386) In this schema, trust is “social trust”, and it is anchored in “social relations, group membership and shared values“, whilst confidence relies on knowledge and familiarity (p.399), and on “past performance, or institutions designed to constrain future performance”(p. 386). In sum, this framework supports situations where the person who needs to be trusted performs in a manner that generates the confidence of those who need to trust others. It allows cooperation between the two groups to occur.

The TCCM network diagram is represented below in Figure 2.3.

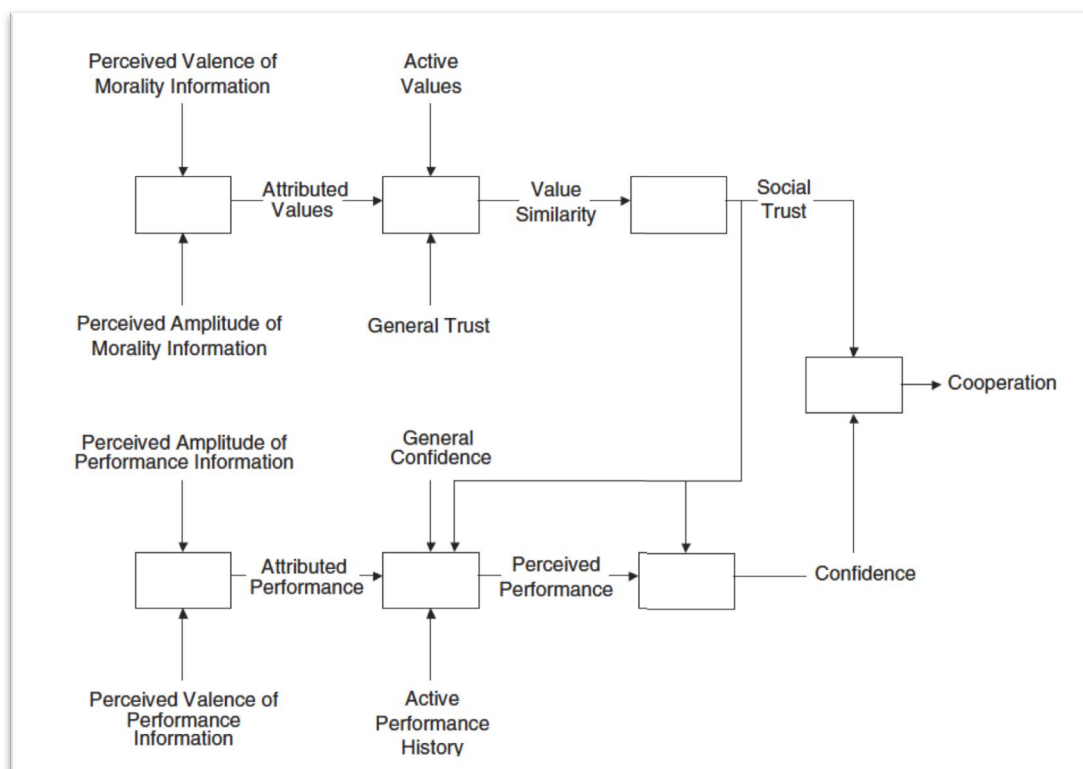


Figure 2.3. The Trust, Confidence and Cooperation Model. Earle and Siegrist (2006 p.387).

So which is more influential in building cooperation? Trust or confidence? In TCCM, it depends on the degree of familiarity that is in play in a situation. As Siegrist et al. (2005) explain: “trust involves risk and vulnerability, it is important when familiarity is low. Confidence, on the other hand, is based on “high levels of familiarity based on experience or evidence” which allows people to believe “that certain future events will occur as expected’ (p.147). In other words, if expectations of the future are relatively

clear (high familiarity), people can cooperate with others when they have confidence in their competence. If expectations of the future are clouded by uncertainty (low familiarity), people might still cooperate with others if they share values, and thereby trust them.

TCCM has application to this inquiry since it allows a specific role for professional performance when experts can provide evidence and call up the “regulations, rules/procedures, contracts...social roles...control...and standards” to frame the risk decisions (Earle & Siegrist, 2006, p. 386). Importantly, TCCM does not preference the experts’ knowledge over non-experts’ values. Rather, it gives priority to trust since “judgments of trust dominated judgments of past performance and of confidence” (p.383). They also identify antecedents of trust that “include social relations ..morality .. integrity ...fairness, and caring” (p.386).

Here we see a wider frame in play around trust, which allows Earle et al. (2007) to position TCCM as “compatible with our participatory form of democracy”(p.1). Mordini (2007) proposes the same for curiosity, finding that it can play a positive role in decision-making because it “is by definition a ‘democratic factor’”. When curiosity is in play, it can promote “information sharing and encourage dialogue ...(and) might allow people to overcome paranoid reactions towards new technology” (p.546).

At this point, we can see that both SARF and TCCM offer ways to understand the challenges inherent in risk communication. In Chapter Eight I’ll provide new versions of both frameworks by aligning findings of the inquiry with them.

So what else is on offer? Let’s go now and explore proposals for a change in approach to risk communication and social engagement.

2.5.5. Looking to the future: Co-constructing knowledge and acknowledging value forms.

“The identification and assessment of risk is a social activity and, as such, is concerned with the production of meaning and a shared understanding of reality” Beck (1992 p.47).

Scholars emphasise the need to lessen tension between realist and social constructionist approaches to conceptualising risk, and pursue theoretical

perspectives that are more relevant to social needs (Flynn & Bellaby, 2007; Irwin, 2007). As we find in future chapters, this goal is not without its challenges, but regardless of the difficulties, researchers find merit in efforts to connect elements of the realist and the social constructionist school (Klinke & Renn, 2002). Broadly speaking, social constructionist approaches position risks as culturally and socially defined, whilst realists position risks as real, objective, identifiable and measurable, and independent of people's perception or cultural beliefs about them.

The tension that exists between realist and social constructionist approaches is evidenced by the mega-debates between adherents to either of the two competing paradigms. Irwin (2007) contends that the long running disputes about risk have led to its ambiguous, contested and opaque character, and Horlick-Jones (2007) notes, and rejects the tendency of some strongly constructionist scholars to conceptualise risk as being "all in the mind", urging a focus on real-world settings (p.41). He allows that risk is hybrid in nature, and that risk is neither just about material artefacts or just a social construction. When this hybrid construct of risk is in play, it brings forward the potential to address "not only the complexity but also the moral and political dilemmas associated with a wide range of risk management problems" (Horlick-Jones, 1998,p.79.). Irwin (2007) proposes a co-construction model to resolve the dichotomy between strong realism at one end of the epistemic spectrum, and strong constructionism at the other. Vandermoere (2008) favours this approach when he identifies gaps between experts, decision-makers and regulatory scientists on the one hand, and social scientists and laypeople on the other. He proposes an ecologic-symbolist model to allow connection between "social and scientific rationalities"(p.388). Connections like this allow for a psycho-social perspective, such as political orientation and environmental values, "but do not neglect empirical data about ecological variables" (Vandermoere, 2008 p.389).

Gregory et al. (2006) are clear on the need to integrate facts and value, and address uncertainty. When these aims are achieved, people are better placed to deal with the "complexity and interdependence of an increasingly large number of risk issues" (p. 5). In their schema, bridging communication gaps is about integrating local and traditional knowledge with science, and thereby avoiding the pitfall of overemphasising expert knowledge at the expense of an integrated process (Gregory et al., 2006 p.727-728). Burger (2013)'s empirical research demonstrates the benefit of utilising the local

knowledge, citing the case of fishers, who were more likely to limit consumption of contaminated fish when they participated in selecting risk levels about contaminants within them.

Other researchers acknowledge the need to integrate social elements into decision-making processes that address real world problems. Petts (2008), for example identifies collaborative framing as a solution, and Miller and Erikson (2013) proposes a process where “individuals, groups, or organizations... can play bridging roles” across competing knowledge systems (p.327). They provide a checklist for assessment practitioners that includes processes around the recognition of different risk perspectives, acknowledgement of local knowledge, the building of mutual trust and respect, and participation in forums and platforms that support negotiation and conflict resolution. Given this, one could ask what an individual could bring to environmental decision-making. Ropeik (2011) proposes that people from the “hard sciences” could better bridge “the perception gap between our fears and the facts” (p.6) if they acknowledge the contribution of soft sciences to the understanding of human emotions.

To this point, we see that misalignment between the meaning of empirical risk and the perception of empirical risk is an impediment to an effective risk dialogue. We also see that a way to lessen any misalignment involves cooperation between participants and their engagement in the co-construction of the meaning of risk, and of the co-design a social engagement process that addresses risk. Another suggestion to improve risk communication involves the construct of social learning. For Wynne (1988), social learning involves experts and non-experts in “interaction of discourses,...measured scrutiny...around capacity of non-experts to critique the value systems inherent in technology”(p.161). He considers social learning to be transformative, part of the informed consent process that involves “adaptive and socially-negotiated measures...(E)xperts would exchange lost power for greater legitimacy” (p.163). Wynne’s perspective is grounded in respectful interaction, negotiated judgement around technology selection and experts’ responsibilities. When these are in play, he argues that they would allow “a change in the overall social balance of control of technology...(which is) not be such a bad thing as far as social justice is concerned” (p.163). Collins and Ison (2009) frame social learning around equity and social responsibility when “new kinds of role, relationship, practice and sense of purpose”

are in play. (p. 358). Strydom (2008) argues that scientific uncertainty can be resolved through risk communication that involves “a cooperative collective learning process” (p.16).

Ison (2004) proposes a framework for social learning called SLIM which aims to promote “adaptive transformations in complex and uncertain situations” (p.366). The SLIM framework allows for memory (past causes), cooperation (build stakeholding through joint responsibility), competing knowledge forms and co-production of knowledge (epistemological constraints) and facilitation (provides necessary facilitation)” (p.366). Steyaert and Jiggins (2007) suggest the SLIM framework when they point to “fresh opportunities for researchers and practitioners to play a privileged role in the emergence of a new kind of socio-technical democracy, i.e. in the development of grass-roots scientific literacy, and the co-creation of knowledge and understanding” (p.584).

At this point, we have identified social sciences literature that points to an identifiable trend in favour of closing the gap between the theory and practice of risk communication and social engagement. Remedies include integration between realist and constructionist perspectives around risk construction, as well as structured interaction between different epistemic groups that reduces tension between competing knowledge forms and values.

We have come to the end of the transdisciplinary literature review, so now we can look at the results.

2.6. Results of review of literature from three knowledge domains.

2.6.1. Bridging content and bridging process.

The literature review reveals how the construction of the meaning of risks, and peoples’ experience of them, change over time under the influence of technological innovation, market forces, political activism and policy drivers around risks reduction. Whilst technical innovation to reduce risks is driven by science, the underlying driver that supports innovation is improvement in risk knowledge, and this emerges from the social domain, when the public becomes aware of pollution risk and demands better

protection. Here we see the connection between the domains of science, social science and the humanities, since all offer understanding of the meaning of risk, in both empirical and perceived forms.

The review finds that whilst risk perception is well represented in research, there is less focus into benefit perception, either as a concept, or as it is experienced by people. However, there is literature that explores benefit. As with risk, benefit can be represented in an empirical form that can be measured, for example, as occurs when remediation is in play and delivers urban renewal and revitalised natural environments. Benefit can also be represented in a perceived form, as occurs when individuals process empirical information and create imagined situations for themselves around new communities and restored environments.

Literature shows that when in play during social engagement, benefit perception can bridge gaps in understanding between experts and non-experts. For example, people see the potential benefit of remediation to their own lives and are willing to support it. This possibility brings to mind Beck (1992)'s concept of reflexivity - a person's response to a situation. When in play in a social engagement situation, reflexivity around benefit, as well as risk might be a way to bring forward positive expectations around a risky situation.

It is at this point in the literature review that the concepts of *bridging content* and *bridging process* emerge.

So what do I mean by these terms and how do I define them? Let's start with *bridging content*, which for this inquiry takes the form of expert knowledge. *Bridging content* rejects fixed positions that characterised former theoretical meta-debates about forms of risk knowledge. It allows for the co-existence of different knowledge forms, and supports integration between them. *Bridging content* can be provided by experts and non-experts, and is delivered through textual and visual forms of communication. I define it as follows: *Bridging content characterises and frames a risk topic so that gaps in understanding between different epistemic communities about it are substantially lessened.*

And what of *bridging process*? It allows non-experts to understand the potential for social and economic benefit around risk taking, and facilitates cooperative, inclusive

and respectful decision-making between themselves and experts about the selection of an acceptable level of empirical risk. *Bridging process* requires acceptance of a role for heuristics, and acknowledges peoples' individual experience and emotional states, and their knowledge and values. I define it as follows: *Bridging process facilitates socially and politically inclusive interaction between people from different epistemic communities over time, so that gaps in understanding about contested knowledge and values are lessened.*

So where to from here? In what way can the use of a *bridging process* and the delivery of *bridging content* improve social engagement and risk communication? These definitions speak to integration and bring forward the idea of integration mechanisms. I discuss them in the following section, where I also identify themes and issues, recurring terms, and historical events that have emerged from this review. As you will see in the next chapter, I draw on all of them to develop my research methodology.

2.6.2. Emergent themes, issues, terms, events and integration mechanisms.

Four themes that are important to effective risk communication have emerged from the review. They are uncertainty, trust, values and time. If risk communication does not adequately account for them, then it can fail.

Regarding uncertainty, it exists in two forms, empirical uncertainty as measured by experts, and perceived uncertainty as understood by non-experts. There is no hard-and-fast rule as to the balance which an individual can allow between these interactive mental processes.

Regarding values, they reflect what is worthwhile to an individual person, or to society as a whole. When values around public health protection are under pressure from contamination impacts and people are uncertain about the risks they pose, values can come to dominate risk dialogues.

Regarding trust, it emerges a key part of a risk-dialogue but is insufficient in itself to support an effective one, since distrust and critical trust must also be present. When non-experts believe that risk knowledge is being withheld from them, they are unable to trust experts. In these situations, non-experts require the right to interrogate

experts, and experts require the capacity to demonstrate that they can be trusted, and that they are competent in their chosen domain of scientific knowledge.

Regarding time, a risk dialogue can fail if consideration of the influence of time is absent. Luhmann (1979)'s understanding of time is useful here. He allows time as either an event in the past that influences people's construction of a risk, or as a state of consciousness that allows people to process risk information using both analytical and experiential modes of thinking.

In the next chapter, I use these four themes to develop tools of inquiry with which to explore the research topic. I do the same with terms and events that are common to all three domains of knowledge, and with five issues that stand out as important around remediation risk and risk communication. They are 'odour and dust', 'risk standards and acceptability', 'industry training needs', 'lack of clarity of terms' and 'participation or people management'.

The literature review also suggests seven integration mechanisms, and as before, I used them to develop tools of inquiry. The mechanisms are fair process, common ground between contested knowledge forms, improved communication through language, improved communication through narrative, improved communication through imagery, awareness of the physical context of risk, and awareness of the mental context of risk. I define integration mechanisms *as mental processes or knowledge forms that encourage cooperation between different epistemic communities to achieve jointly desired and compatible outcomes.*

In Figure 2.4. below, I provide a representation of the literature review which shows transdisciplinarity at work between the three literature domains.

Now let me introduce you to the research questions. There are two:

Question 1. Is there evidence of expert content and processes that can bridge gaps in knowledge and understanding between experts and non-experts who participate in social engagement processes?

Question 2. Do existing models, frameworks and institutional guidance about social engagement offer useful ways improve the practice of risk communication?

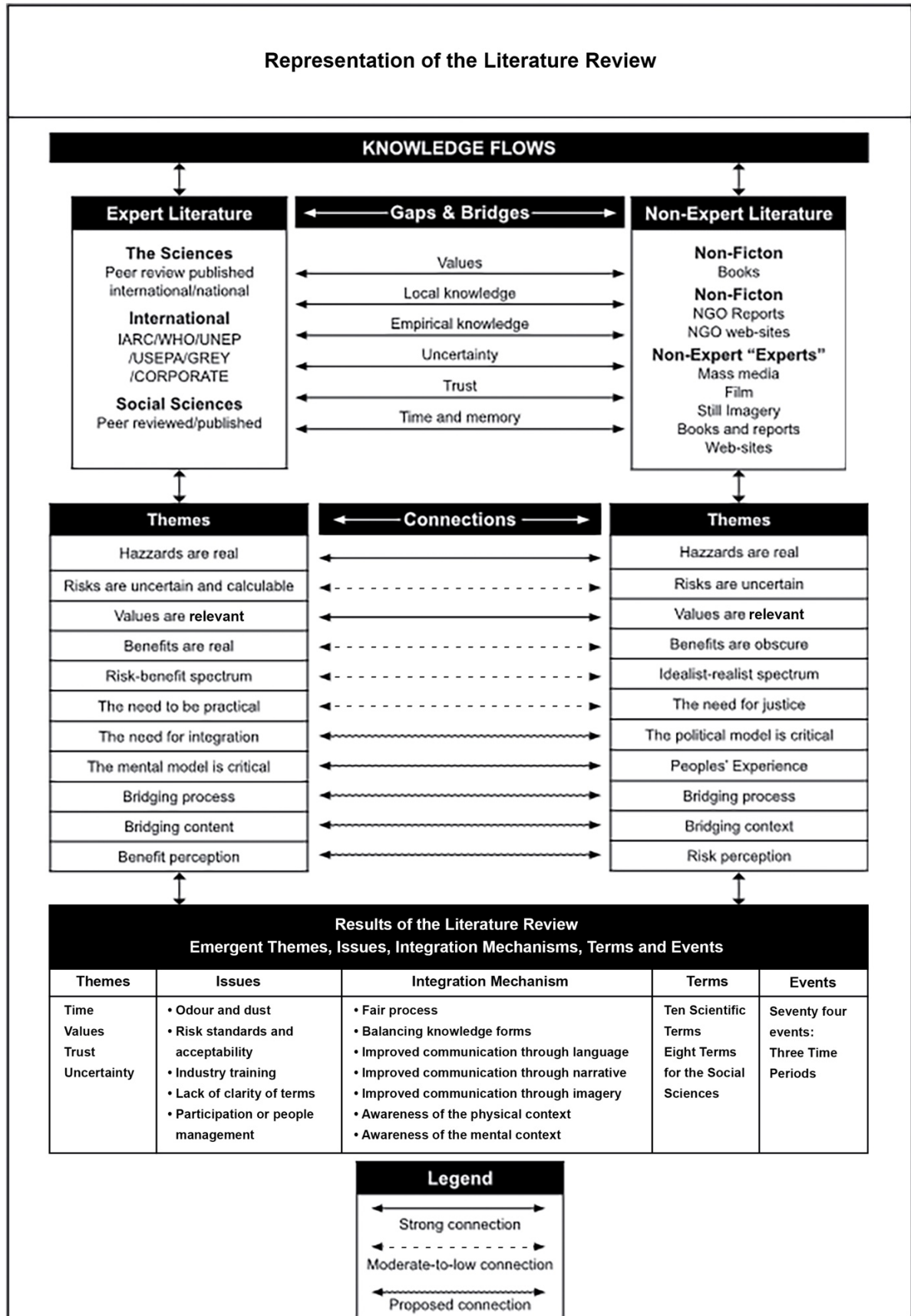


Figure 2.4. Representation of a transdisciplinary literature review.

2.6.3. The contribution of the literature review.

The results of the literature review informed the development of the thesis structure and the selection of suitable tools of inquiry. I will refer to key literature throughout this dissertation, since as we might allow, the literature review is all around us as we go on our research journey.

The themes identified in the literature review are time, values, trust and uncertainty. They are starting points for the first three of the five findings chapters about experts' capacity to bridge communication gaps (Chapters Four, Five and Six), and are also evident in the remaining two (Chapters Seven and Eight).

As to the issues, they are associated with hazard, risk and risk selection, communication, training and social engagement formats, and are in play throughout the dissertation. They pertain to the social and political context of risk, and construction of the meaning of hazard, risk and risk selection, and are discussed in Chapters Four and Seven. Their scientific meanings are discussed in Chapters Five and Six, where their socially constructed meanings are also in evidence.

Regarding the key terms and events, as with the themes, they are present in various chapters. They are also used to develop research tools in the form of two questionnaires which are presented in Chapters Four (Key events) and Seven (Key Terms). As to the integration mechanisms, they contribute to analysis in Chapters Seven and Eight, and provide support for the findings about risk communication and social engagement. In the Chapter Nine, the connections between expert and non-expert knowledge forms and values suggested by the literature review support the consolidation of findings and inform the claims made.

Let's go to the next chapter now, where I describe and explain my research design, methodology and method.

Chapter Three. The research inquiry described.

“A pragmatist perspective...can fulfil its constructive potential only when extensive theoretical preparation is combined with systematic data analysis. Multiple theorizations increase the researcher’s ability to construct generative abductive inferences. They do so, however, only in relation to meticulous empirical observations and methodological routines” Tavory and Timmermans (2014 p.49).

3.1. Introduction.

I designed my research inquiry to allow the best possibility of answering the two research questions. Here, I describe its structure, beginning with the philosophical framework and the methodology, followed by explanations of the method of inquiry, data collection tools, analytical method and the claim-making process. Table 3.1. below provides a representation of the structure of my research inquiry.

3.2. Explaining the qualitative (dominant) methodology.

This inquiry is about phenomena that do not easily lend themselves to quantitative analysis. Mental constructs like ‘values’, and ‘trust’ are understood differently by different epistemic groups, and by different individuals, and processes like ‘risk communication’ and ‘social engagement’ are similarly experienced differently. On the other hand, concepts such as ‘risk’ and ‘uncertainty’ can be understood both qualitatively and quantitatively. Empirical risk and uncertainty can be calculated using mathematical formulae, whilst perceived risk and uncertainty are, in the context of my inquiry, best understood using a quantitative methodology. Both methodologies apply to contamination risks, and these are a focal point of the inquiry. For this reason, the research was undertaken using predominantly a qualitative methodology. A mix of qualitative and quantitative methods was used to analyse results from two questionnaires. The responses from one questionnaire were analysed using *MS Excel*, followed by thick description analysis. For the other questionnaire, I used basic numerical calculations to classify the responses, followed by thick description analysis. This combination of qualitative and quantitative analysis constitutes a mixed method as described by Onwuegbuzie et al. (2009) and Dutcher et al. (2007). Since the

majority effort was applied to qualitative analysis, I nominate my methodology as Qualitative (Dominant). Table 3.1 below explains the key elements of the inquiry.

Structure of the Research Inquiry	
Research Topic	Expert Risk Communication
Ontological Position	Critical Realism
Research Design	Epistemic Approach: Pragmatism
Methodology	Mixed Method: Qualitative (Dominant) Mode of inference: Abduction
Method of Inquiry	Case Study
Tools of Inquiry	In-depth interview Focus group Image and media surveys Two questionnaires
Analytical Techniques	Coding Thick description Grammatical analysis Semiotic analysis Statistical analysis and numerical calculation Visual analysis Content analysis
Construction of claims	Via abduction

Table 3.1. Structure of the research inquiry.

3.3. Ontological and epistemological selection.

“Empirical associations require illumination by theory before knowledge of them could be interesting or useful.” Stretton (1969. p.251).

The next step was to select my ontological position, and after reflection on available options, I selected critical realism. I find support for this in Gorski (2013)’s presentation of Bhaskar’s body of work. Gorski explains that critical realism “appeals to the real *ontological* distinctions between the various layers...between the natural and the

social worlds” (p. 659), proposing that the critical realist “sees science as a human activity that is inevitably mediated (if not determined) by human language and social power” (p. 664). Moon and Blackman (2014) define critical realism as “reality captured by broad critical examination” (p.1169), explaining that the critical realist “assumes that one reality exists but can never be understood perfectly” (p.1170). Their relational diagram positions it centrally on an ontological spectrum and Table 3.2 below provides a summary.

At one end of the ontological spectrum is naïve realism, which allows people to understand reality if they choose particular methods. At the other end is relativism, where multiple realities exist as constructs in peoples’ minds. I am comfortable in the middle of the spectrum, where critical realism allows for reality to be captured by broad critical examination. In this I am encouraged by (Boucher, 2012)’s emerging version of the critical realist approach that provides an “account of technology and its account of meaningful processes” (p.246) Boucher uses a critical realist approach to explore reasons for value dissimilarity about a phenomenon and in this inquiry, I do the same, exploring why different groups understand a technological risk differently, and as a result fail to communicate about the degree of risk and how to reduce it.

ONTOLOGY				
Naïve Realism..... Critical Realism Relativism				
EPISTEMOLOGY				
Objectivism Constructionism..... Subjectivism				
APPLICATIONS OF EPISTEMOLOGICAL POSITION				
To Predict e.g. Positivism using scientific method	To Understand e.g. Hermeneutics Phenomenology	To Emancipate e.g. Critical Theory	To Deconstruct e.g. Post- Structuralism Post-Modernism	Any or all Applications i.e. Pragmatism

Table 3.2. Summary of relational diagram. Derived from Moon and Blackman (2014).

To this point, I have selected something from the world from which to acquire knowledge. Now I will explain how I selected my epistemological position.

To undertake a research inquiry, one has to decide on its purpose. My inquiry cannot be one whose purpose is to predict that something will happen, as scientists and some social scientists do when they create evidence using a quantitative methodology.

Moon and Blackman (2014) are helpful here when they explain that whilst both scientists and social scientists might identify something that exists in the world about which they want to acquire knowledge, they approach inquiry about it in different ways. They have different reasons to undertake research and ask different questions to argue for their particular version of reality. My inquiry does not aim to predict something, nor is its purpose to create change or deconstruct. Rather it is to explain why a particular situation exists (Armstrong, 2010). The situation is gaps in communication between experts and non-experts, and my inquiry seeks to understand the reasons why 'the expert' can, or cannot communicate with non-experts about the meaning of an empirical risk.

My inquiry then, seeks to understand rather than predict, anticipate or deconstruct. There are various ways I might do this. I could, for example, select hermeneutics, since it aims to understand hidden meaning of language as reflected in texts, practices, events or situations. I did apply a double hermeneutic during analysis when I interpreted the interpretations of participants in the inquiry, but it was not used as the overarching frame of inquiry. I also considered phenomenology as a process of inquiry. Frost et al. (2010) provide an example of its application when they describe interpretative phenomenological analysis as "concerned with a detailed examination of individual lived experience and how individuals are making sense of that experience" (p.445). That sounds interesting, but I'll heed the advice of Gorski (2013) who warns about the limitations of strong constructionism where natural science, like social reality is "linguistically constructed" (p. 660), and "just another part of life-that...is governed by (impersonal) 'discourses' and 'powers'" (Hardwick & Cook, 1977 p.661).

The remaining option available is pragmatism and mixed method researchers are enthusiastic about its value. For example, Feilzer (2009) supports pragmatism when she urges a shift in emphasis from an internal academic perspective to one that explores "our understanding of society and social life" (p.14). Johnson and

Onwuegbuzie (2004 p.18) value the way pragmatism focuses on recognition of the natural world, the social world and the psychological world. Onwuegbuzie et al. (2009) identify distinguishing characteristics of pragmatism, including reliability and warranted assertability (See Table 2, p.123), and Morgan (2007) positions it as an alternative to qualitative and quantitative research well suited to research into the nature of the external world (Table 3, p.71). Tavory and Timmermans (2014) prefer pragmatism because it relies on abduction as the mode of inference. In their schema, abduction has potential to reflect the way that people actually do look at the world when they try to make meaning of it (p.36). Morgan (2007) explains abductive reasoning as the process of “working back and forth between the kinds of knowledge” (p.71). In this sense, abductive reasoning is suited to trans-disciplinary research, where moving between domains of knowledge is required. Krippendorf (2004) support the use of abduction since it allows the researcher to “proceed across logically distinct domains” (p.36), and Feilzer (2009) appreciates abduction as it supports “sharpening or rethinking within the research method.... pragmatism is a commitment to uncertainty, an acknowledgement that any knowledge ‘produced’ through research is relative and not absolute...from the outset...the data collated as part of research may not ‘fit’ the research question as well as desired, that it may point to uncertainties and a ‘human element’ that was not considered at the design stage” (Feilzer, 2009. p.14.).

At this point, let’s consider Tavory and Timmermans (2014)’s understanding about the value that abduction brings to a research inquiry. They allow that as a mode of inference, abduction offers a way to produce novel generalisations by connecting and re-connecting empirical observations of a social world with any number of theoretical propositions. As they explain: “In good research these two parts of the story not only intertwine but amplify” (p.6). They draw on Peirce’s idea of “recursively moving back and forth between a set of observations and a theoretical generalisation”, a process from which empirically based theorisations can be constructed (p.6). Abduction then, is best understood as a continuous process of constructing meanings, or generating a new hypothesis about something in the world. It can be either an abstract idea or a physical thing. Social scientists can select abduction as an approach to analysis, and lay people use it constantly to make sense of their daily life.

When applied to a qualitative inquiry, abduction has features that distinguish it from the two other modes of inference: deduction and induction.

Firstly, abduction requires researchers to abandon adherence to a single theory on the grounds that a single theory cannot accommodate all knowledge. “Knowing the theory” then, is better understood as “extensive familiarity with existing theories” (Tavory & Timmermans, 2014 p.42.), and thinking through what they might contribute to an inquiry. By taking this approach, a researcher can access a wide range of ideas and possibilities which can help identify gaps and inconsistencies within an area of inquiry, recognise anomalies, and allow a place for surprises and unexpected findings. As the inferential procedure unfolds, abduction stimulates further insights, and, if undertaken with care and rigour, can lead to the construction of new theoretical insights. Peirce refers to this process as creative inference. It requires researchers to make use of theories and applications of semiotics as a way to support creative thinking about anomalies (Hardwick & Cook, 1977). Abduction presumes that we are already familiar with potential explanations for anomalous findings, and the technique of resisting familiarity is another of its key features.

Resisting familiarity involves a conscious breaking away from patterns of habitual thinking. Tavory and Timmermans (2014) refer to them as “habits of thought” that are deeply ingrained because researchers “occupy a certain set of social positions which colour our observations by allowing us only partial access to the field by shaping the way in which our interlocutors interact with us, and by arming us with proto-theories of the world” (p.41). In this way, habitual thinking must be acknowledged and then resisted to allow the evidence to better illuminate the effect-to-be explained.

Tavory and Timmermans (2014) are consistent in their advice to resist familiarity, emphasising the need to avoid an overly easy alignment of findings with a preferred theory. They cite grounded theory as an example of an analytical approach which often fails to do this by “forc(ing) the data into the straitjacket of existence of pre-existing concepts” (p.6). In contrast, abduction offers researchers a way to resist the lure of familiarity represented in “some well-trodden forms of analysis”, and to look elsewhere for an explanation about something that is surprising, and clashing “explicitly or implicitly” with the researcher’s preconceptions. “Without such preconceptions, nothing can be either surprising or unsurprising” (p.49). It is in this way that unanticipated and surprising observations are strategic. They provide an opportunity to develop new theories or novel generalisations. As Peirce explains it, abduction (from the Latin ‘leading away’) “denotes *the process of forming an*

explanatory hypothesis when confronted with a set of unexplainable observations" (Tavory & Timmermans, 2014 p.36, original italics).

Resisting familiarity privileges a strongly relational and active form of reasoning, and is akin to Beck (2016)'s idea of "reflexivity'(self-confrontation)" (p.64). It allows researchers to account for any observation they might make about a phenomenon in relation to other observations, and by this means uncover a previously hidden and unknown cause or effect, or explain what appears to be an unexplainable or surprising observation. In this way, as Tavory and Timmermans (2014) explain, abduction starts with consequences and then constructs reasons by allowing a proposition to be "guessed at, presumed after the fact to explain observations that are not easily explained away" (p.37).

Not all qualitative researchers agree with this, on the grounds that any conscious positioning of a researcher's perspective will support biased selection of data and a highly subjective construction of its meaning. For example, Chenail (1997) draws attention to methodological traps that exist for qualitative researchers who are studying what they have previously practiced. His remedy is to adopt the posture of not knowing, which, from the abductive perspective, is hardly possible since a researcher already has the object of study in mind, and cannot avoid conjecture, or disregard ideas and hunches, about how to further illuminate what it means. Stretton (1969) might support this, since he argues that it "is not by detachment from the 'object' studied, but by moral and humane respect for the people studied" that yields a "near-perfect understanding, which leaves the object comparatively undistorted by the observer" (p.192). See also Stretton (2018 pp.287-288). Tavory and Timmermans (2014) come from a different scholastic domain to Stretton, but there is an underlying alignment. As they understand, when abduction is used as a method of inquiry, it is precisely the researchers' unique perspective on the world - their "socially located, positional knowledge -that can be deepened and martialled for the purpose of theory construction" (p.41).

Before we leave this explanation as to why I selected abduction, it is worth noting that this inquiry does not conform to commonly practiced sociological research, where open-ended conversations, observation of interactions between people, the taking field notes, coding and the checking and re-checking of transcripts are central to the

method of inquiry and associated analytical methods. Nor did I gather data by observing interactions between groups in a social situation, or exploring an environmental stimulus or biological parameter. My inquiry was trans-disciplinary and relied on multiple strands of evidence generated from analysis of in-depth interviews, a focus group, image and media surveys and two questionnaires. It reflects Peirce's schema where abductive reasoning allows multiple strands of evidence to come together to form, not "a chain which is no stronger than its weakest link, but a cable whose fibres may be ever so slender, provided they are sufficiently numerous and intimately connected" (Johnson & Onwuegbuzie, 2004 p.18).¹⁵

Extending the analogy, the cable of reasoning I aim to create draws on threads of theory, and uses tools and techniques to create strands of evidence and a pattern of findings. Here, I follow Stretton (2018)'s ideas about what to select and how to argue. He allows that particular "strands of causation" can be followed to explore "the complex patterns of cause and effect", in order to "understand the necessary mix of facts, judgements, values and social purposes that shape our imperfect knowledge of cause and effect" (p.288).

To this point, I have identified my epistemic approach and research methodology. By adopting pragmatism and using abduction as the mode of inference, I aim to uncover evidence to support any claims I might make about experts' capacity to bridge communication gaps between themselves and non-experts. My research methodology does not rely on representation to establish claims, since they are based a combined weight of evidence generated by a six lines on inquiry, which includes, but is not exclusively reliant on, findings about a small sample of experts.

Let's go now to consider the method of inquiry.

¹⁵ These researchers quote Peirce (1868) as represented in Menand (1997, pp. 5–6).

3.4. Method of inquiry. The case study method.

“Methods are ... codified processes designed to maximise objective reasoning, in which we force ourselves to remain with the phenomenon and try to form as many links and hypotheses as possible in light of our theoretically positioned knowledge”. Tavory and Timmermans (2014 p.61)

When selecting the method of inquiry, I aimed to ensure that it was firstly, suited to the investigation of the research topic (expert risk communication), and secondly, capable of addressing the research questions. I selected case study, albeit with an appreciation that there is lack of consensus as to whether case study is a method or a methodology. Some researchers consider it to be a methodology, whilst others just consider it to be a way to place a boundary around a research inquiry and gather data. For example, Heath (2005), Onwuegbuzie et al. (2009), Cresswell (2007) and Goodrick (2012). Other social scientists use case study as a method to explore concrete issues in depth and within their context, including Hammersley , Benn et al. (2009) and Armstrong (2010).

Hopwood (2016)'s adaption of Hammersley's approach shows case study framed within research design. As you can see in Figure 3.1. below, the research design relies on a case study for the generation of data.

Applying this framework, I identify risk communication and social engagement as the 'big picture', and 'the expert' as my 'case' – the unit of analysis.

Evidence was generated by analysis of data collected from in-depth interviews with experts, from two questionnaires that experts responded to, from media and image surveys, and from a focus group of non-experts. Considered together, these six tools of inquiry might provide a sufficient weight of evidence to support any claims I might make about theories and frameworks about risk communication and social engagement, and about the capacity of experts to bridge the communication gap between themselves and non-experts.

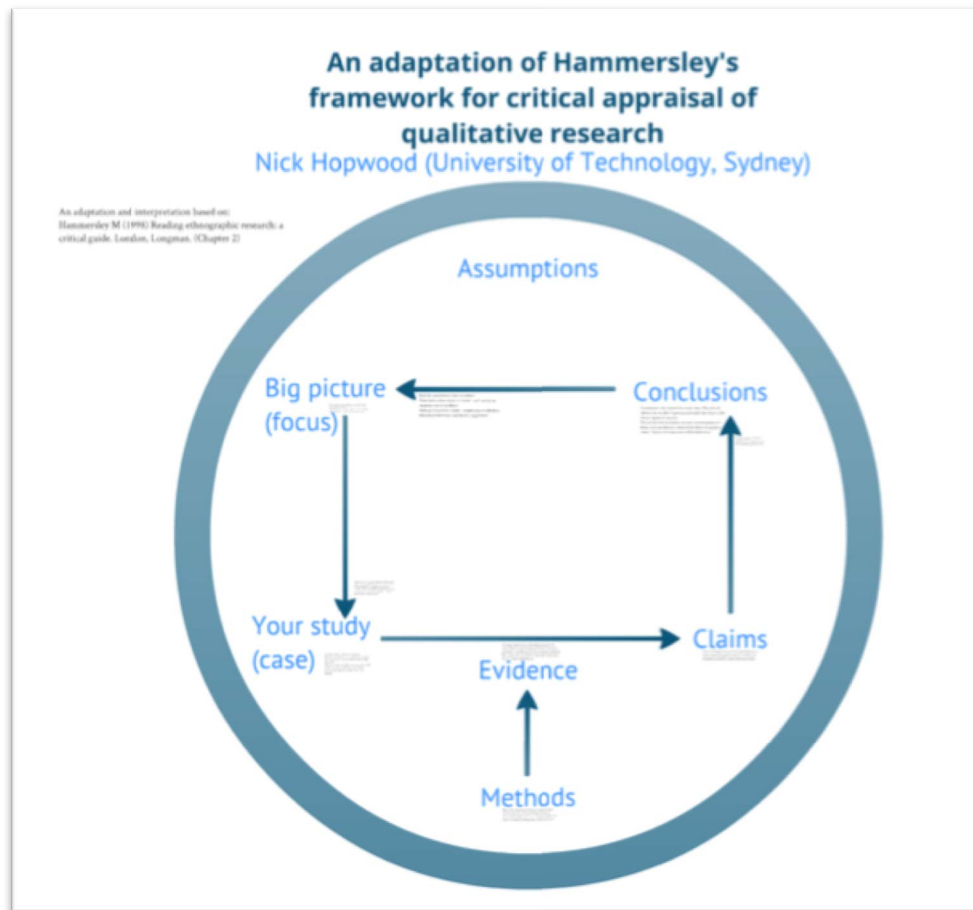


Figure 3.1. Hopwood's Summary of Hammersley's Framework. With permission: 26-07-2016.

3.4.1. The case study explained.

My case study aims to explain why some experts can communicate the meaning of an empirical risk whilst others cannot. It investigates why there are gaps in understanding about the meaning of an empirical risk, and what changes to the way 'the expert' communicates could improve risk communication to non-experts during social engagement. As residents living near a remediation site, non-experts are potentially exposed to hazardous emissions from a remediation technology, and this exposure can constitute an unacceptable risk to human health. In this case study, we assume that communication about health risks is, in itself, a public good on the grounds that an experts' role is to reduce empirical risks and produce benefits by way of less environmental pollution, reduced potential for human exposure to contaminants, improved local amenity and opportunities for urban renewal.

3.4.2. The unit of analysis.

“Has each writer and reader an absolute right to name his own curiosity?”
Stretton (1969. p.26)

Human activity ...is so complicated that most causal analysis of it-most
accounts of what causes what-has to be selective.” Stretton (2018 p.279)

The choice of ‘the expert’ as the unit of analysis reflects my interest in science and technological change, and in individuals who can make a difference to the world because of their knowledge and approach to solving problems associated with pollution. At this point, I need to acknowledge my closeness as a researcher to the topic of inquiry, and draw on Armstrong (2010)’s approach to managing subjectivity. She requires that researchers adopt “positional reflexivity...(which) involves sceptical, self-critical consideration (p.882). Over a period of thirty years, I have seen experts in action at remediation sites, and have witnessed how an environmental liability can, with the right approach, be transformed into a social asset. This experience brings forward the potential for the researcher effect to be in play during my inquiry, and it stands as a limitation to the methodology. In Chapter Ten, Section 2, I address this and other limitations. Here, I explain how I selected the experts and describe the data collection process and method of analysis.

In selecting a case study approach, I followed the common practice of qualitative researchers to select a group using purposive, rather than representative or random sampling. As Teddlie and Yu (2007) explain: “Purposive sampling leads to greater depth of information from a smaller number of carefully selected cases, whereas probability sampling leads to greater breadth of information from a larger number of units selected to be representative of the population” (p.83). By using purposive sampling, researchers can work “with non-statistical samples of people who are nested in their context and studied in-depth” (Miles et al., 2014, p.30).

Researchers study experts. For example, Lefsrud and Meyer (2012) explore the construction of expert identities when they investigate the views of experts who work as corporate representatives, and make findings about expert claims for independence and lack of partisanship. Driedger et al. (2002)’s investigation of experts illustrates variation in the meaning of scientific uncertainty, and Evans and Plows

(2007) explore the terms 'experts', 'scientists' and 'publics' and find them unhelpful, preferring the terms 'experts' and 'non-experts'.

For this inquiry, we select the terms 'experts' and 'non-experts'. Experts comprise a professional group with responsibilities for cleaning up contaminated sites, and as such, play a central role in communicating the risks and benefits of a technology to non-experts. As Armstrong (2010) allows, they are groups who self-identify and are conscious of boundaries that set them apart from others

There are over sixteen hundred professionals engaged in land and water remediation in Australia (Kryszkiewicz, 2020), and during the course of their work, they can participate in social engagement about risk selection and risk management with non-experts. It follows then that selecting "the expert" as the unit of analysis will support the aim of the inquiry which aims to illuminate the-effect-to-be-explained - the misalignment of meaning between experts and non-experts about the meaning of POPs remediation risks.

I define experts as people who are professionally competent in one or more aspects of remediation sciences, and non-experts as people who have limited understanding, knowledge and experience about remediation risks that they are asked, by experts, to take. I do not adopt Evans and Plows (2007)'s definition of experts that includes people competent in science who are members of NGOs, but this does not mean that I am unaware of this possibility.

Let's go now and look at the tools of inquiry.

3.5. Tools of Inquiry.

To select suitable tools of inquiry, I drew on the results of Chapter Two (the Literature Review), and following Gorski (2013), applied an approach drawn from critical realism. As he explains, "critical realism ... continually reflects on and revises its own categories and instruments. Its ontology is provisional and fallible" (Gorski, 2013 p.659). I used six techniques to collect data and this approach allowed me to address the two research questions in different ways.

Prior to commencing the inquiry, I obtained ethical approval by gaining the written consent of participants, and disclosing to them information about its purpose. (Hansen,

2006). The purpose of the Consent Form was to allow informed consent, to protect the identity of those participating in the research, and to explain to participants how potential risks to reputation would be managed. The Information Sheet described the objectives and scope of the inquiry. I was conscious of the need to apply an ethical approach rigorously during interviews and the focus group, since the potential to compromise privacy, or cause discomfort was always possible. Experts, of necessity, value personal reputation and need to maintain professional integrity, and non-experts value their individual privacy.

See Appendix 3.1. In-depth Interviews: Information

See Appendix 3.2. Focus Group: Information

3.5.1. In-depth interviews.

Spoken and written language is used for human communication, and for this inquiry, I refer to it as textual language. Textual language allows communication through the use of words, as distinct from non-textual data which allows communication through the senses, including vision and touch. We consider non-textual data in Section 3.5.2. below, and more textual data in ensuing sections. Here we describe the method used to collect textual data from in-depth interviews.

In-depth interviews were undertaken to collect data from a cohort of remediation experts. To select a suitable cohort, I advertised in industry journals by placing an Expression of Interest in two journals, and also used professional networks to distribute it. This exercise proved successful and I was able to recruit experts, mainly from Sydney, N.S.W., for the inquiry. Figure 3.2. below shows one of the advertisements.

Seventeen experts were willing to participate in the inquiry. They were professionals with technical expertise, and/or expertise in social engagement and communications. All had extensive experience, with an average of more than 15 years in the industry and on-site experience at remediation sites where POPs and other contaminants were present, as Figure 3.3. below shows.



UTS
UNIVERSITY OF TECHNOLOGY, SYDNEY

Institute for
Sustainable
Futures

Expression Of Interest

In-Depth Interviews

Expressions of interest are sought from professionals in the remediation industry to participate in in-depth interviews. The interviews are part of a doctoral research project on risk communication about POPs pollution remediation.

The project is exploring gaps in communication between experts and non-experts about remediation technology. It is part of CRC CARE's SPART Program ('Societal Perceptions and Acceptability of Remediation Technologies') which is being conducted at the Institute for Sustainable Futures, University of Technology, Sydney.

Remediation professionals have a key decision-making role assessing remediation technology and deploying it in land clean-up. They may also play a role in communicating to the public about remediation risks. For these reasons, their views are being sought through a formal interview process.

The in-depth interviews will investigate how professionals explain the risks of contaminated site remediation to the public. They will explore the use of language and imagery, including graphics, photographs and maps. The overall aim is to gain insight into how the risks and benefits of remediation are communicated by experts to non-experts.

Ten participants are being sought. Each interview will take 90 minutes and all relevant ethical procedures will be adhered to.

If you are interested in this project and would like more information, please contact Kate Hughes on 02 4568 2118 or email [here](#).



Figure 3.2. Author's Expression of Interest invitation to experts. Source. Cronicle. May 2015. Australasian Land and Groundwater Association.

EXHIBIT 1 Experience of 17 experts on nine remediation sites in Sydney, Australia

Identity of site	POPs-contaminated sites (containing dioxin-like POPs, DDT, and HCBs)					PAH-contaminated sites (containing nonhalogenated PAHs)		
	Sydney Olympic Park	Former Union Carbide Site	Homebush Bay	Two sites at Botany Industrial Park	Villawood	Barangaroo	Breakfast Point	Former HMAS "Platypus"
Experts experience on site	10/17	10/17	8/17	11/17	10/17	8/17	5/17	10/17

Figure 3.3. Experience of 17 remediation experts on nine remediation sites in Sydney, Australia. Source: Hughes (2017 p.77).

I prepared an interview *pro forma* designed to draw out the meanings that experts construct about remediation risks. My approach was to inquire, in depth, about their knowledge, understanding and experience of risks, both in empirical and perceived form. I aimed to encourage the authentic voice of the expert to emerge, and was aware that there could be limits to their freedom to speak about aspects of their work due to commercial-in-confidence provisions in a contract. To transfer a broad mix of

questions across into a suitable interview *pro forma*, I reflected on the four themes that emerged from the literature review; time, values, trust and uncertainty. As the review makes clear, social sciences literature about risk communication can focus on the roles of values and trust, and to a lesser extent on time, whilst scientific literature gives a lot of attention to empirical uncertainty. Given this, it was logical to ensure that these themes were reflected in the interview *pro forma*.

I also reflected on the value of the seven integration mechanisms that emerged from the literature review. By way of reminder, in Chapter Two I define these constructs as mental processes or knowledge forms that encourage cooperation between different epistemic communities to achieve jointly desired and compatible outcomes. In social science research in particular, these constructs have been shown to influence the effectiveness, or lack of effectiveness, of risk communication, so as before, it was logical to ensure that they were reflected in the interview *pro forma*. Similarly, the issues that arose in the review were useful to the development of questions.

Using these above themes, constructs and issues, I developed an interview *pro forma* populated with questions designed address the two research questions. It comprised a mix of open and closed questions, beginning with straightforward first level questions and proceeded to more complex questions. Closed questions referred for example, to their experience, sites worked on, qualifications and lifestyle preferences. Open questions sought opinions on a range of subjects familiar to experts, including technological innovation, corporate frameworks, hazard, risk and uncertainty, trust, and processes associated with risk communication and social engagement.

At this stage of the inquiry, UTS human ethics approval was obtained.

Prior to undertaking the interviews with the cohort, I conducted pilot interviews with two retired experts.¹⁶ The aim of the pilot was to test the suitability of the semi-structured interview format as a technique that could offer both focus and flexibility (Hurworth, 2012), and as well to test the suitability of the interview questions themselves. The two pilot interviewees were provided with the Information Sheet, each signed the Consent Form, and then the pilot interviews were undertaken. I used the

¹⁶ Later, when analysing responses from one of the questionnaires, I did include responses from one of the pilot interviewees, having been informed that it was acceptable to do so.

feedback to identify poorly worded questions and inconsistencies in others. I then revised questions, retaining some and retiring others, the latter including those about family situation and some personal preferences. I also reviewed the wording of all questions to achieve maximum objectivity. The end result was the Interview *pro forma* which contained four levels of questions. The first explored the experts' experience of work and life, the second further explored the experience of work, the third inquired about technical issues and the fourth was non-technical in nature, exploring the relationship between the experts and the non-experts with whom they had had contact.

The interviews with the cohort of experts began with the distribution of the Consent Forms and Information Sheets, and arrangement of the interview schedule. Once the Consent Forms were signed, I began the interviews. Immediately prior to each interview, I confirmed that the participant had signed a consent form, read the Information Sheet and understood that the interview would be recorded and transcribed. I then confirmed that they understood how confidentiality would be maintained during transcription through de-identification of each interviewee and the removal of any reference to site owners and site management. Finally, I asked if there were any matters needing further clarification.

The seventeen interviews lasted between 90 and 120 minutes. I endeavoured to ask every interviewee the same questions, but in several cases, I failed to do so and omitted certain questions. In two cases I did not ask interviewees some questions because they lacked direct experience at remediation sites, being experts who developed risk assessments. I allowed each interviewee sufficient time to respond, and probed respectfully when responses provided clues which suggested the value of more detailed discussion.

At the conclusion of each interview, I invited participant to complete two questionnaires in the privacy of their home or office. One was related to historical events, and the other was about the meaning of terms. I explained that there was no obligation to complete them, and invited the interviewees to seek further information about the questionnaires at any time. I also asked interviewees if had been able to respond to a written request for remediation imagery and if they had, I collected them for later analysis.

3.5.2. Image Survey.

The meaning of things can be communicated by non-textual as well as textual language. Non-textual language includes music and the visual arts, and it creates meaning through experiential mental processes, appealing to peoples' memory, their senses and emotion (Berger, 1972; McLuhan & Fiore, 1967). Non-textual language can also be in the form of imagery, including photographs and graphics, and these convey meaning through analytical as well as experiential mental processes. (Bessel et al., 2007; Flood, 2012; Ogilvy, 1963; Prosser, 1996; Tufte, 1990).

For this research, I explore non-textual language, predominantly in the form of imagery, and refer to it as 'visual language'. As mentioned above, prior to interview, I invited experts to provide examples of imagery that had been, or was being, used in risk communication, including but not confined to, social engagement situations with residents living near remediation sites. I asked experts to select examples from their own, or others' work, and to explain the reasons for the selection, asking them to nominate 'good', 'better', 'best', and 'bad', 'worse', 'worst' examples. By this means, I aimed to explore variation in the quality of imagery that experts use in risk communication. Some imagery was provided in material form, and it was collected and stored. Other imagery was provided digitally through web sites, and their domain addresses were recorded. A set of digital photographs was provided by one expert.

3.5.3. Focus Group.

The design of the focus group drew on the guidance offered by experienced practitioners. They emphasise the benefit of a well-planned approach, for example Fern (2001), Hurworth (1996), Packer-Muti (2010) and Hansen (2006). To select participants, I drew on Hurworth (1996)'s advice to ensure they had a common link and selected participants with "similar/common status and/or interest" (p.49). For this inquiry, participants comprised non-experts with knowledge, experience or understanding about POPs site contamination and exposure risk. It was conducted after all other analysis had been completed.

To select a suitable group, I considered various options.

The first option was to recruit a mix of non-experts from two different communities who had a shared experience of a POPs remediation technology and had participated in social engagement about it. Both social engagement processes were associated with

the destruction of the first generation POPs, dioxins, using the same direct thermal desorption plant to destroy contaminated soils or sediments.¹⁷ One group were non-experts who had participated in the Botany, N.S.W.-based Community Participation and Review Committee (CPRC), and the other group were non-experts who had participated in the Rhodes Community Consultative Committee (RCCC).

The second option was to recruit a mix of non-experts who had recently been, or were currently, experiencing POPs contamination in their community by the second generation POPs, PFAS (Australian Government, 2019a). There were several dozen such communities from which to choose, including one situated in Richmond, N.S.W.

The third option was to recruit a mix of people, including those who had previous direct experience of POPs remediation, and people who had no such experience.

I chose the third option and selected participants who had been members of the Rhodes Community Consultative Committee, or who lived in, or near to Richmond, N.S.W. where there is a PFAS contaminated site which is yet to be remediated.

To recruit participants, I invited members of the community environment network in Richmond, and ensured that invitations included an Information Sheet about the aims of the focus group and mentioned the need to provide written consent for the use of data. I issued the same invitation to former members of the Rhodes Community Consultative Committee. Six participants were recruited from the Richmond community, and two from the Rhodes Peninsula community. Another participant from the Richmond community joined the focus group as it was underway.¹⁸ A well-patronised community venue in Richmond was selected as the location for the focus group.

The focus group program was designed to allow for representations of both risk knowledge and risk communication, and to ensure suitable content selection, I explored three options. One option was to use of data fragments with narrative power sourced from interview transcripts, together with images uncovered during the

¹⁷See the on-line video *Pass the Baton* Doldissen, A., Saville, C., & Hughes, K. (2011). *Pass the Baton* K. Hughes; SummerLea video. <https://www.youtube.com/watch?v=QgpirKyCyg&feature=youtu.be>, for detail. Go to http://www.sydneyvideomakers.org.au/svmc/video_list.asp?producerURN=0&comp=0&VidCat=0&titleSearch=Pass+the+Baton&button=search+film+library

¹⁸ This community member provided no RSVP and arrived at the mid-point of the focus group. It was not appropriate to turn him away.

literature review. Another option was to use events, situations or terms drawn from the two questionnaires. The third option was to select a mix of images, including some from the image survey (see 3.5.2 above) and some from texts and imagery about current PFAS contamination in Australia. Including PFAS imagery was important, since a Commonwealth of Australia (2019) inquiry had found that PFAS have contaminated land and water in all Australian jurisdictions, generating widespread public concern about human exposure to them. Given this, I selected the third option and designed focus group activities around current text that communicate about PFAS risk, and around imagery selected from the image survey and from expert visual communication about PFAS risks.

3.5.4. The Milestones Questionnaire.

The Milestones Questionnaire explored experts' understanding of the historical context of empirical risks associated with anthropogenic pollution. It ranked experts' awareness about events associated with the origins of their industry and its changing regulatory status. The questionnaire aimed to establish if experts remembered these events, and if they thought any of them might have influenced public consciousness about polluting technologies and their remedies. In this way, the questionnaire aimed to explore experts' awareness of the psycho-social context of pollution. Psycho-social is a catch-all term that refers to individual and social memory and experience of pollution. The National Academies of Science Engineering and Medicine (2017)'s research agenda reflects a psycho-social context in that it seeks "to identify important influences—psychological, economic, political, social, cultural, and media-related...issues", and how they are "understood, perceived, and used" during risk communication (p.1).

To populate the questionnaire, I drew upon the results of the literature review where historical events had been mentioned in all three literature domains. I selected seventy-four events on the basis that were about industrial accidents, scientific discoveries about pollution impacts, or signalled the publication of information or the promulgation of a law or convention that addressed the causes of these accidents and impacts. The events deployed a NSW focus, were framed within a national and global context and classified into three periods: 1961-1978, (seventeen years), 1980 to 1995 (fifteen years), and 1996 to 2013 (eighteen years).

See Appendix 3.3. Milestones Questionnaire.

The questionnaire was provided to each interviewee on completion of the in-depth interview, and included an invitation to complete them later. The invitation requested experts to indicate as to the relevance of each of the seventy-four events by ticking one of three boxes. Each response allowed three possible responses. If the expert accepted the event as relevant, s/he ticked 'yes', if rejected, s/he ticked 'no', and if an event might be relevant, s/he ticked 'maybe', thereby indicating provisional acceptance. The participants were given the opportunity to add other events that they remembered as important. You will find the results in Chapter Four.

3.5.5. The Key Terms Questionnaire.

The Key Terms Questionnaire explored experts' capacity to communicate empirical risk by the use of scientific and social terms. It was designed to gather data about the scientific and social literacy of the experts and as with the Milestones Questionnaire, I drew upon the findings of the literature review, where eighteen terms were identified. Eleven were drawn from the scientific literature and were associated with empirical risk. Terms included basic ones such as 'density', as well as more complex ones like 'exposure pathway', and their definitions were drawn from reference texts of suitable quality. You will find the results of the questionnaire in Chapter Seven.

Seven terms were drawn from the social sciences and were associated with social engagement. They included commonly used terms such as 'stakeholder', as well less common ones like 'upstream engagement'. As with the scientific terms, I sought their definitions from reference texts of suitable quality. Five terms were defined accordingly, but as for the remaining two, when I scrutinised definitions I found that they were not yet standardised. In these cases, I adapted content and meaning from several sources to create new definitions. The terms defined in this way were 'transfer or risk' and 'upstream engagement'. I defend this choice on the grounds that it aligns with my identification as a critical realist. As Gorski (2013) allows, critical realism "continually reflects on and revises its own categories and instruments. Its ontology is provisional and fallible" (p.659). You will find the results of the questionnaire in Chapter Eight.

See Appendix 3.4. Key Terms Questionnaire.

3.5.6. Media survey.

A media survey was undertaken over a period of four years and involved the collection of print media articles where the word 'toxic' was used.

In doing this, I was guided by Stretton (2018) who argues that "at the heart of any causal analysis of complex social life is... a role for imagination" (p.284). His approach allows an "eccentric measure... to permit reliable repetition and comparison, albeit of wilfully chosen features of societies" (Stretton, 1969 p.177). For this inquiry, the eccentric measure is reflected in the nature of the survey, and the "wilfully chosen" feature is the mass print media. It can also be considered an exercise in curiosity, which is encouraged by those who use the abductive mode of inference to explore a research topic. As Tavory and Timmermans (2014) explain, being curious allows a researcher to respond to surprises that emerge during the course of an inquiry, and to account for them even though they are unfamiliar and do not align with existing understanding about the object of interest. As they explain it, words can "clash explicitly with a vision of what the world should be like, how processes should unfold, and how actors should behave" (p.42). The word 'toxic' could align with this schema since, in the sciences, the word 'toxic' is associated with a domain of scientific knowledge called toxicology (Wallace, 2011) and during my research journey, I had become increasingly surprised at the ways which it was being used in knowledge domains not associated with the sciences. To explore the possibilities offered by this conundrum, I considered Bryant and Oliver (2009)'s analysis of media content. Although it covers a wide range of topics, including those that consider how language is used to create specific effects and attitudes, it provides nothing specific on the mass media's use or mis-use of scientific language,. This suggested the value of identifying how the scientific term 'toxic' is used in print media as a way to explore the extension of meaning of words. On this basis, I decided to satisfy my curiosity and use samples from the print media to populate a survey for use in the research inquiry.

To this point, I have identified six tools of inquiry and described the method of data collection. In the next section, I explain my approach to data analysis.

3.6. The analysis: Components and approach.

In this section, I describe the seven techniques used to analyse data. As explained in Section 3.2 above, I have adopted a mixed methods approach to analysis, using a predominantly qualitative method. The methods used are coding, thick description analysis, grammatical analysis, visual analysis, content analysis and semiotic analysis. Where I used a quantitative method to generate data, I used statistical or simple numerical calculation.

3.6.1. Coding.

Codes can provide a stable frame for the analysis of textual data (MacQueen & al, 1998), or, as Bryman (2008) allows, are mutable- “in a constant state of potential revision and fluidity” as the researcher reviews, and re-reviews data in the light of existing knowledge and theory (p.402).

In this sense, codes are not neutral. As Bazeley (2013) and Miles et al. (2014) propose, researchers select them to guide analysis and bring their own interests and values to their inquiries. For Miles et al. (2014), “a code is a researcher-generated construct that symbolizes and thus attributes interpreted meaning to each individual datum for later purposes of pattern detection, categorization, theory-building, and other analytic processes” (p.71). Twenty years earlier, the same approach is evident in Miles and Huberman (1994)’s network graphic which illustrates the iterative nature of hypothesis coding (p.304, Display 13.1. Overview of Qualitative Data Analysis processes).

Hypothesis coding is what occurs when researchers apply an abductive mode of inference. As Tavory and Timmermans (2014) argue, a credible researcher is one who is theoretically sensitised. Familiarity with theories at the beginning and throughout analysis is positioned as “a core requirement of abduction” (p.42).

Any number of codes can be selected and used in a variety of ways, (Boeije, 2002; Miles et al., 2014; Nicolini, 1999; Santos & Chess, 2003; St. Pierre & Jackson, 2014). Santos and Chess (2003) for example, refer to “themes, concepts and patterns” as a way to assign meaning to information (p.272).

Researchers distinguish between open and axial coding. They have different purposes and can be undertaken sequentially. For example, Tavory and Timmermans (2014) observe that “in open coding the questions may go in all kinds of directions (and some) questions will require additional data gathering.” In this schema, open coding is followed by axial coding where the researcher looks “across data sources to flesh out key conceptual dimensions and to account for variations” (p.54).

As techniques, both open and axial coding have limits and cannot be relied upon as the sole method of generating findings that address the effect to be explained. Bryman (2008) and Jackson and Mazzei (2013), for example, consider that exclusive reliance on coding tends to fragment the data, resulting in loss of context. Tavory and Timmermans (2014) propose that the overuse of coding constitutes a weakness, identifying research inquiries where detailed narratives are collected, ordered according to “a rudimentary taxonomy” as a way of allowing “the data speak for itself” (p.1). This approach is evident in the work of Reed et al. (2014), where coding is undertaken without a credible classification or hierarchy of organising principles. (See Fig.2. p.340).

I developed a series of codes using a reflexive, iterative process. I began by acknowledging my own values and reflecting on my ontological position as a critical realist and epistemological position as a pragmatist. I see the material world as one beset by the paradox of progress where there is constant tension between the risks and benefits provided by industrial and post-industrial technology. This position aligns with that of Beck (1992), who constructs this paradox in terms of a risk society, where experts have choices about whether they defend the status quo using their scientific literacy, or contest it in defense of the public good. For this research, if experts opt for Beck’s second option, they could be positioned as exercising a degree of social literacy, a construct that emerged from the literature review. I selected this construct as a code and continuing the code selection process, considered the themes, integration mechanisms and issues that had also emerged from the review. They showed promise with respect to answering the research questions and I selected them as codes. Table 3.3. below identifies the codes.

Codes used in the analysis	
A construct	Social literacy
Themes	Time, values, uncertainty, trust
Integration mechanisms	Fair process The need to balance the contribution of different knowledge forms Improved communication through language Improved communication through Imagery Improved Communication through narrative Awareness of the physical context of risk Awareness of the mental context of risk
Issues	Odour and dust Risk standards and acceptability Industry training needs Lack of clarity of terms Participation or people management

Table 3.3. Codes used in the analysis.

3.6.2. Thick description.

Early practitioners of the thick description approach include the foundation cultural anthropologist Clifford Geertz, (Geertz, 1960, 1973a, 1973b). His research influenced modern ethnographic research which, as Crotty (1998) explains, is used to “uncover meanings and perceptions...viewing these understandings against the backdrop of the people’s overall worldview or ‘culture’” (p.7).

Crotty’s words convey that a situation can be rich in meaning, and suggest thick description. So why is a description ‘thick? Freeman (2014) explains it around “the ability to create a rich, contextualized description of an event to increase verisimilitude and transferability of the findings” (p.827). Goodrick (2012) references, but does not name, thick description analysis, explaining that case study research can facilitate “a rich thick description of the phenomenon under study, using prose and literary techniques to describe, elicit images and analyse situations” (p. 31). St. Pierre and Jackson (2014) consider thick description can “foster new questions that loosen the grip tradition holds on our imaginations and demand that we consider how the ‘topic’ we study is thinkable” (p.718), and Jackson and Mazzei (2013) suggest that analysts

ask “new questions and different ways of thinking research (sic) and data after coding in a process of plugging one text into another.”(p.269) As with Tavory and Timmermans (2014), these researchers alert the researcher to the benefits that imagination and creativity can bring to analysis. Feilzer (2009) reference to Kuhn’s reminder to practitioners of pragmatism of “their ‘duty’ to be curious and adaptable” (p. 14) resonates here.

In my inquiry, thick description analysis follows open and axial coding of data from in-depth interview and focus group transcripts, is applied to responses from the questionnaires after statistical and simple numerical calculation, and to visual and content analysis. It involves iterative revisiting of coded data and identifying, features of the text around, for example description, variation, example, comparison, analogy, opinion and the use of verbs. In this way, I was able to generate themes and ideas from which I was able to infer specific attributes about experts and their language.

To extend the power of findings, I undertook further analysis of experts’ language using a grammatical approach.

3.6.3. Grammatical analysis.

I used grammatical analysis to explore experts’ language, applying Butt et al. (1995)’s ideas around functional linguistics. They propose classifying text in terms of genre, The Finite and grammatical structure. Genres distinguish between types of texts, for example, Information Reports, Explanation, Narrative or Exposition. The Finite is verb or a verbal group that assign either timing and motivation to the subject of any text. Grammatical structures provide for the overarching classification of discourse with three types identified: the “Field of Discourse”, the “Tenor of Discourse” and “Modes of Discourse”. They support the identification of connections between the structure of a text, its meaning, and its context.

3.6.4. Statistical and numerical calculation.

I used the generic spreadsheet software program *MS Excel* to analyse numerical data generated from the Milestones Questionnaire. The aim was to rank a set of events in readiness for further analysis via thick description. Regarding the Key Terms Questionnaire, a simple numerical calculation was undertaken to distinguish between different responses to terms, followed by thick description analysis.

3.6.5. Visual Analysis.

Visual analysis can be applied to anything visual, which for this inquiry is imagery in the form of photographs and technical representations such as network diagrams, graphs or maps. McCandless (2009) offers a wide variety of these forms of visual imagery but a number of them reflect a lack of design principles, resulting in attractive but overly complex or confusing images. Flood (2012)'s presentation of poster art offers examples of imagery purposely designed to communicate specific messages, including risk messages where design principles are much in evidence. Frankel and DePace (2012) provide practical guidance on graphic design, focussing specifically on features that enhance the accessibility of technical communication.

I selected a technique of visual analysis that drew on design principles as proposed by Estrada and Davis (2015) and Priest (2015). For Estrada and Davis (2015), visual design is a discipline with organising principles around composition, abstraction, colour, layers and refinement (simplifying and editing)" (p.146). For Priest (2015), design principles are those that enhance the meaning of object in the image. For example, infographics "may stimulate deeper thought", visual information "can enhance comprehension of text-based information" and map features "may influence the reactions of those who view them" (p.4).

Maps can have political power (Harley, 1988) and can be used as a communication tool or for public education about a risk. Severtson (2015) considers the effectiveness of map features in her research into the representation of uncertainty during communication about cancer risk. Features that convey "the accurate gist of risk magnitude and uncertainty" (p.83) are those that support bottom-up processing. This means that the person for whom the map is constructed needs to be able to immediately understand its overall meaning. Severtson (2015) identifies a specific pattern of shaded colour and contour focus as the most effective visual features to communicate cancer risk. Another form of map is a mind map which presents textual information in the form of a network diagram. They are diagrams that show the different ideas associated with a particular concept. They can be used as a kick-off point for a group brainstorming exercise, or constructed from its results. The subject of a mind map is usually shown in the middle, while the different ideas are shown branching off in different directions It can represent, for example, a construct like trust,

an object such as a technology, or, as with this inquiry, a particular type of person, such as an expert. Visschers et al. (2007) anticipate a mind map when they place the name of a hazardous substance in the centre of a network diagram with branches to represent the various associations people can have of it. (Fig.1., p.718)

3.6.6. Content analysis.

The media survey was analysed using content analysis (Stemler, 2001) to explore the extended meanings of a key word used in the sciences and associated risk assessment. The analysis began with the selection and classification of data that contained the word “toxic” followed by thick description analysis.

3.6.7. Semiotic analysis.

I applied the Peircean schema of semiotic analysis to explore how non-experts construct meaning about ‘the expert’ using a selection of expert knowledge forms. Semiotic analysis explores how individuals or a community of inquirers construct meaning, and uses abduction as the mode of inference. As Tavory and Timmermans (2014) explain, the process of meaning-making begins when a person observes the “object”, and in their mind create an object-sign relationship. It is from that relationship that an “interpretant” emerges as the immediate translation of the object-sign, which simply put, is its meaning. Tavory and Timmermans (2014) explain the relationship between them as “the transformation that the interpreter undergoes while making sense of a sign.” (p.23)

The sign exists only in relation to the object, in the way that smoke (the sign) cannot exist without the fire (the object). Together, object and sign bring forward the interpretant, which, by way of example, in the case of the fire, the smoke could elicit an understanding about food being cooked, or alarm that a house is on fire. These might be meanings that emerge immediately, but if more time is allowed, other processes of meaning-making can occur and generate multiple meanings, when semiotic chains of objects, signs, and interpretants are continuously constructed. The interpretant then might be an understanding not about food or danger, but about a ceremony or a social event, that they recall after thinking about the situation. In this sense, “anything can be signified in numerous if not infinite, ways -and can evoke multiple interpretants” (p.28). Meaning making then, is a practical achievement

whereby “the effect of the sign-object is taken up in the world... through understanding, emotions, or action” (p.27), through “the lens of the interpreters particular proto-theoretical categories, preconceived notions, habits and preferences” (p.25-26).

3.7. Analytical techniques.

In this section, I describe how I analysed data.

3.7.1. Analytical technique used for in-depth interviews.

Seventeen interviews were transcribed and anything pertaining to the participants' identity was removed. To maintain data integrity, original transcripts were retired from the inquiry. Each de-identified transcript was given a number and then securely stored for later analysis.

Analysis began with a quick read-through of each transcript, followed by open and axial coding, and completed using thick description analysis. Table 3.4 below provides examples of axial coding and Table 3.5. of thick description analysis.

Further analysis of in-depth interviews was undertaken using grammatical analysis, applying Butt et al. (1995)'s framework. It allows investigation of “grammatical patterns in an objective way (to)... see how the users of language create meanings and achieve intended effects” (p.141).

Examples of axial coding of data		
Code Name	IDI	Data
Risk standards and acceptability	1	<i>Most Australians have .. some level of exposure...the damage chemicals can cause to health.</i>
	6	<i>Debate about whether we should have an acceptable risk level of one additional cancer in ten to the five, or ten to the minus six.</i>
Fair process	1	<i>An American company that had a view that they didn't give a damn what the community felt.</i>
	6	<i>The economics of businesses are really what drives them.</i>
Trust	1	<i>Make sure that I understand what the objective is...remove the blockages so that whatever is meant to happen can happen.</i>
	6	<i>You really can't convince people about your independence except by being independent.</i>
Awareness of the physical context of risk	1	<i>The persistent ones like dioxins, hexachlorobenzene</i>
	6	<i>Birth defect statistics in a bullseye around the facility and incinerator.</i>
Social Literacy	1	<i>Enhance my self-awareness.</i>
	6	<i>I'm very sceptical of a lot of stuff I hear...from the print and the TV media.</i>

Table 3.4. Examples of axial coding

Thick Description Analysis		
Experts' understanding of the meaning of public and private values		
IDI	Data	Inference
3	<i>I'm not sure I know those terms...equity and fairness for all people?</i>	Invokes an ethical frame
4	<i>My values...how I see and deal with other people in the world around...as opposed to public values...something that a corporation would publish as being the values of the corporation.</i>	Acknowledges economic power
7	<i>Private values [are] personal values that an individual holds...public values [are] the standards and morals and ethics by which the majority...believe in.</i>	Invokes an ethical frame
15	<i>The number one is to treat others as you would like to be treated yourself...egalitarian type culture value.</i>	Invokes an ethical frame

Table 3.5. Thick Description Analysis: Examples of data and their inference

3.7.2. Analytical technique used for focus group.

The focus group generated data from non-experts about the textual and non-textual content of expert risk communication, and as well about experts themselves. For this exercise, textual content is words and groups of words, and non-textual content is images, and hereafter is referred to as visual content.

There were two types of textual content that generated data. The first type contained participants' opinions about expert texts. The texts were analysed using a two-step process, firstly exploring annotations placed on the texts by individual participants, and secondly via thick description of transcripts of group discussion about them.

The second type of textual content contained participants' opinions about experts themselves. Participants expressed their opinions in a quick individual exercise and during an interactive group mind-mapping exercise. In this exercise, utterances from participants in group discussion were assigned *verbatim* to a mind map represented on a sheet of paper. Data from the quick group exercises was analysed first, followed by analysis of data from the mind mapping exercise. The data was combined for the purpose of further analysis.

Data from visual content was analysed firstly using parameters drawn from design principles around composition, (use of icons and colour), layers (area delineation) and refinement (use of text, complexity, currency of information). This was followed by thick description analysis that explored the context of the image, and then by a semiotic analysis that explored the meaning of particular objects.

3.7.3. Analytical technique used for questionnaires.

There were two questionnaires, the Milestones Questionnaire and the Key Terms Questionnaire.

The Key Terms Questionnaire contained ten scientific terms and seven social sciences terms. The responses were analysed in two stages. Let's look first at the analysis of the scientific terms.

The first stage of the analysis of scientific terms used a comparative method to investigate experts' capacity for accuracy when explaining the meaning of a term sourced from their domain of knowledge. A simple numerical calculation was

undertaken to assess the degree of alignment between explanations provided by experts and those selected from formally recognised sources. Three categories were selected to represent the degree of alignment: 'Sufficient', 'Limited' and 'Non-compliant'. A fourth category was provided to record other responses. The second part of the analysis used thick description to investigate the clarity of experts' language by assessing the meaning, as distinct from the definition of each term. Four criteria were used to select data that could explain the meaning, as you can see in Figure 3.4 below. You will find the results of this analysis in Chapter Seven, Section 3.1.

EXHIBIT 3 Types of thick description

Criteria	Explanation
Description	Provides meaning by describing characteristics of terms
Use of verbs	Provides meaning through the selection of verbs
Examples/comparisons	Provides meaning by giving examples or making comparisons
Other	Provides meaning by allowing for a personal response

Figure 3.4. Types of Thick Description. Source: Hughes (2017 p.77).

Analysis of the seven terms from social sciences was similar. Experts' capacity to explain them was assessed by measuring the degree of alignment between their explanations and the definitions, and the same four categories of alignment used to analyse scientific terms were applied. I undertook further analysis using thick description to compare experts' understanding of the meaning of terms with their definition. Three terms were selected on the basis that the explanations provided were the least well aligned with the definition. I established this by calculating the sum of the total responses that attracted sufficient and limited. You will find the results in Chapter Eight, Section 8.3.

The Milestones Questionnaire was analysed using *MS Excel*. My aim was to establish if there was any consistency in the way all the experts ranked the milestones, and to establish their overall ranking. The results are presented in Chapter Four, Section 4.4.1.

3.7.4. Analytical technique used for media survey.

A collection of texts was sourced from hard copy editions of newspapers issued from March 2014 to March 2018. I scanned each clipping and assigned them to a digital folder. I first identified each media item, recording its content and date of creation. Each item was then analysed using thick description, which allowed classification of the issues discussed, and their allocation to specific media domains.

3.8. Limitations.

There are always limitations to a research inquiry. For my inquiry, limitations include those around the auto-ethnographic sub-text, the sample size selected for the unit of analysis, and several aspects of the questionnaires. I address these and other limitations in the final chapter (Chapter Ten, Section Two).

At this point, I conclude the description of the research inquiry. A summary of methodology is provided in Table 3.7. below.

The Research Inquiry Summary of Methodology					
Ontological Approach Critical Realism					
Epistemic position Pragmatism					
Analytical Method Mixed method					
Analytical Technique	Tools of Inquiry				
	In-Depth Interviews	Image Survey	Focus Group	Questionnaires	Media Survey
Coding	yes				
Thick description analysis	yes		yes	yes	
Grammatical analysis	yes				
Statistical/Numerical calculation				yes	
Visual analysis		yes	yes		
Content analysis					yes
Semiotic analysis			yes		

Table 3.7. The Research Inquiry. Summary of Methodology

Now I present the research findings, beginning with findings about values, time and the individual.

Chapter Four. Analysis and Findings: Values, Time, and the Expert as an Individual.

This is the first of five chapters that provide findings from the research inquiry. Findings are about the expert as an individual and how they understand time and values.

The research assumes that all individuals, bar the genuine hermit, belong to groups. There are social groups around family, community, recreation, religion and culture, economic groups around corporations and their networks, and political groups around public and private institutions, organised labour and civil society. When people from different groups participate in a risk dialogue, they might share some values, hold opposing values, or something in between. Their memories and experiences of risky technologies of mutual interest might differ, as might their assessment of what constitutes an acceptable or unacceptable risk.

4.1. Key concepts about values, time and the individual.

Science is not devoid of values (Guston, 2001). As Bohnenblust and Slovic (1998) explain, it is “difficult, perhaps impossible, to completely separate value from technical judgments” (p.724).

Scientific values are in play when experts make a conscious selection of an acceptable level of risk (Lefsrud & Meyer, 2012). As to what ‘acceptable’ means, as we have seen in Chapter Two, contestation takes place between scientists and the public, and among scientists themselves. Vrijling et al. (1998) propose that acceptable risk is a matter of political choice, and Evans and Plows (2007) allow for a technical as well as a political phase, where the technical phase involves questions of fact and the political phase involves questions of preferences, where competing values come into play. In Driedger et al. (2002)’s schema, political phases require mandated science, when “multiple value forms are in play, as well as different knowledge forms” (p.799).

Cvetkovich and Earle (1992) argue that few scientists are equipped to apply values to decision-making around public policy, something that Ellison (2018) and Carignan (2017) account for as a tension between risk selectors and risk takers. Tensions can be addressed if a risk dialogue is undertaken before the risk comes into play, as one

report about broad-acre remediation establishes. (Pym & Sydney Olympic Park Authority, 2001). It describes how public values around the protection of health were identified prior to the mobilisation of a major remediation project, and then progressively folded into the remediation design.

Here we see a situation where scientific and public values converged around health and safety issues, something that Zsolnia (2003) recognises as a “multiple perspectives (where there is an) appropriate balance across diverse value dimension.”(p 289) By way of contrast Hamilton et al. (2006) argue against the use of a multiple-values perspective when hazard assessment of products and substances is being undertaken. Hazard assessments “should ideally be performed by experts” (p.2). In these situations, where it is the harm that a substance can cause that requires assessment, preferencing expert knowledge over non-expert knowledge is logical. However, when the situation involves risks associated with exposure to a hazardous substance, researchers in inter-disciplinary fields see the benefit of recognising all values that are in play. After all, measuring exposure is one of the most challenging tasks for epidemiologists since there is a values dimension to the selection of “at risk” populations (Ahlbom, 1993).

Gregory et al. (2006) acknowledge the need for integration of social elements into decision-making. As they explains, “what society is supposed to tolerate or accept can never be derived from looking at the evidence alone.” (p.37) Similarly, Colborn et al. (1996) position a safer and healthier future around “value judgements...(We ask) how much risk we are willing to entertain (p.246-247).

Here we see support for the inclusion of social values in risk selection. Be they private or public in nature, they draw from the same wellspring of ideas about moral responsibility, ethical choices, social justice, equality, and inter-generational equity. Protected values include the right of people not to be involuntarily exposed to hazardous substances. Society overall may assume that this is a good thing, but Cross (1998) challenges the assumption that public values are necessarily good, in that whilst they can be legitimate, they can also be “ignorant or illegitimate, subjective, tainted by misinformation and available heuristics.” (p.27) However, recognition of private values might be important because they could point to a lack of social

conscience within large corporations. As Chapter Two shows, corporations can act irresponsibly and unethically and cause harm to people and the environment.

At this point, we move from consideration of values to consider time and its potential to influence the experience of risk and the efficacy of risk communication.

Luhmann (1979) understands time as constituted in two mutually exclusive ways: “objective time’ (is) a continuum of points which is the same for all human beings..., something that can be identified as an *event*, ...fixed at a point of time and which is unrelated to any present experience...*Or*, something that can be identified as *state*, which persists regardless of change over points of time. ...States, ... can only be identified as they exist in the present...These two perspectives are mutually exclusive.” (p.11, underlining added)

Greene (2013)’ also addresses the relationship of the past to the present, mentioning the “importance of connecting the now to the past, of honouring the parts of the past that should endure and of nurturing some sense of continuity in our acting in and sense-making of the world” (p.254). Similarly, Hunter (2015) proposes that “we make history present as more than just a context, an event, or location” (p. 219, underlining added). This perspective is useful as it assumes “that history and psychology are always mutually constitutive...experience...is always saturated with historical significance, whether recognised or not” (p.219).

Svenson (1991) points to the importance of time during risk communication when he identifies a temporal orientation around “how often a person’s thoughts concern events in past, present, and future” (p. 268). He finds that “when communicating risk, an understanding of how time perspective enters the receiver’s view of the world facilitates the communication” (p. 267).

These insights about time suggest that its consideration could be relevant to the efficacy of risk communication, where the risk has a backstory with negative connotations. We will explore this later in the chapter when we look at findings from the Milestones Questionnaire.

Let’s go now to the findings about values that emerged from the in-depth interviews with experts.

4.2. Findings about values.

Having values defined...actually talking about them and trying to write them into documents and communicate...is very useful...gives you a strong platform to work on. Remediation expert.

During in-depth interviews, experts were asked three questions about values. The first asked them to explain their understanding of company values, and the second their understanding of corporate responsibility. A third question was around the difference between public and private values, and was asked in relation to trust.

4.2.1. Company values.

Experts hold a variety of views about the meaning of company values. There is an ethical perspective around *honesty, moral and ethical standards, reliability, integrity, respect, and trust*, or a pragmatic perspective aligned with *client focus, leadership, and safe work practices*. Sometimes company values extend beyond the company boundary by *valuing people and the environment* or the *protection of health*.

Experts are sceptical about company values. *Corporates tended ...to be unreliable in terms of integrity. Many of them get away with what they can. Public companies* ¹⁹ *.. may say the right things... but many of them don't put this into practice.* Experts explain this gap between words and deeds around a tension between achieving financial responsibility and exercising social responsibility. Social responsibility is supported by *the inherent values of a good company, giving attention to sustainability or social equity...(We) try to fold that through into the commercial framework.* The problem is that when experts do this, they can find themselves at a commercial disadvantage to those who look solely to the money side of a project. *If you're not competing on a level playing field (i.e. not everyone is committed to the same extent that you are), this usually gives people financial advantages. At the end of the day, the economics of businesses are really what drives them.*

Experts consider that some regulators lack integrity around the values of sustainability. For example, when a government agency *only paid lip service to the achievement of*

¹⁹ Public is used here in the sense of companies listed on the Australian Stock Exchange. It does not refer to companies that are owned by governments.

sustainability, or produces a tender of two pages, with the word sustainability five times in the two pages, asking for no sustainability criteria or analysis of sustainability.

To conclude, I find that:

Firstly, experts can identify financial and social aspects of company values.

Secondly, experts can understand, and can negotiate around, the tension between different value forms.

Thirdly, experts' understanding of company values supports their awareness of the socio-political context of commercial activities.

4.2.2. Corporate responsibility.

Corporate responsibility involves.. *activity that doesn't impinge ...negatively but actually contributes positively, by ensuring that there is no adverse impact on the environment, on the community.* Remediation expert.

Experts understand corporate responsibility within either a broad or narrow frame. The narrow frame is around *shareholders* and private economic interests, and the broader frame *encompasses your responsibility to your sub-contractors, to your employees, to communities...other stakeholders...* It is being *in tune with the communities, the triple bottom line and the ethics that go along with it.* Experts understand this situation as having a *social license to operate*, and are aware of situations where corporate responsibility is entirely absent, including in emerging industrial economies where companies use *child labour*. Remedies to these situations include auditing of the *chain of procurement* and taking *responsibility for quality in your production*. Corporate social responsibility is also connected with an individual's personal qualities, in that an expert can be a *good citizen, or the captain of a ship*

Experts identify a tension between the need to protect private economic interests and the need to promote social good. Experts recognise that *nothing is ever perfect.... You do the best job that you possibly can. You can't just have a financial brain, you must have a moral conscience about the decisions that you're making as well...One is very quantitative, and the other is much more qualitative, and it's hard to get that balance.*

Experts refer to *the combination of ethical as well as legal requirements*, and the need for information to be relevant, accessible and of suitable quality. *You don't conceal information from the community, from clients.*

To conclude, I find that:

Firstly, experts can distinguish between the financial and social aspects of corporate responsibility, and understand that there can be tension between them.

Secondly, experts can recognise that, as individuals, they have limited capacity to resolve these tensions.

Thirdly, experts' understanding of corporate responsibility can support their awareness of the socio-political context of commercial activities.

4.2.3. Private and public values.

I don't think there should be any difference between private values and public values. There can be a marked distinction. There perhaps shouldn't be.
Remediation expert.

Experts understand private values as personal standards about how to act in the world. They refer to the ethical constructs of *truth, humility, respect and integrity*. Private values are *principles by which you live your life. It's good to be true to yourself. The number one is to treat others as you would like to be treated yourself*. Private values are *imposed in that you impose them on yourself*, and can be strongly held and defended: *Some people have very strong views and other people...not as strong...Those views may change over time.*

Private values include *protection of health*. They can be around occupational health where the expert is aware of *the demanding requirements of working on a site that had a risk of significant harm or death*. They can be around infant and child health. For example, *you have a young mother with a baby and her private value is to protect that child at any cost. No risk is the only acceptable level of risk for that child*. Regarding risks to child health, experts understand that private values can clash with values embodied in, say government immunisation policy. As one expert explains, *individuals ..view...immunisation...as too big a risk for their own child ...That's their individual*

value, but the...public value is that all children should be immunised because it's for the greater good.

Regarding public values, experts explain them as *a set of principles about the greater social good or the social benefit. They're just embodied in the community, the norms of that society, the standards and morals and ethics... which the majority...believe in. They are by their nature imposed values around a fair society, or a fair go.* Public values can be reflected in *values around environmental regulation... planning laws, or in a community value, such as making sure that children are not put at risk when they're playing on council playgrounds.*

Experts recognise that tensions exist between their private values and those that are in play in the corporate or social world. One expert explains that *I go to work and the company values are wealth creation, and that might not necessarily be my particular values, and another that you might be remediating a site which ultimately has to be good for the community...but individuals may not feel that.*

One expert is not confident in the capacity of experts to understand how to act in social engagement situations where private values are in play. *It's something that scientists and engineers are often quite bad at, because they're thinking people rather than feeling people...They know in theory, but they don't really get that people have values. Unless you understand, you can't possibly communicate properly with people.*

Experts understand that public values differ within a nation and explain the variation in terms of *history and experience.* Public values are *highly variable across a group of individuals, to do with their upbringing, socio economic background and their life experiences.*

Experts are not familiar with the terms public and private values. They *were not something that rings a bell for me.* Others are sceptical about whether public values exist. As one expert quipped: *You hear three word slogans coming out of Tony Abbott, and you think, 'is that really what public values are?' I think almost there is no such thing.*

To conclude, I find that:

Firstly, experts can understand the meaning of private and public values.

Secondly, experts can distinguish between private and public values and can explain why there are tensions between them.

Thirdly, experts' understanding of public and private values supports their awareness of the socio-political context of commercial activities

Overall, I find variation in experts' understanding of values, and a shared understanding about the socio-political context of commercial activities. The question then arises as to why variation or convergence exists. In the next section, I provide findings about the expert as an individual, aiming to shed more light on how they experience their own world.

4.3. Findings about the expert as an individual.

Experts exist as individuals within their industry, and as individuals living in family and community. Findings about them were generated from in-depth interviews and the focus group.

4.3.1. Findings from in-depth interviews.

During in-depth interviews, experts were asked about their age, experience and lifestyles. All experts have tertiary qualifications, including PhDs, Masters and Engineering degrees. Two have qualifications in communications and one is an architect. At the time of interview, three of the 17 experts were aged between 35 and 49 years, ten between 50 and 64 years, and four between 65 and 76 years, 3 of whom have recently retired. Regarding experts' industry experience, six have between 25 to 30 years in the industry, eight between 15 and 24 years, and three between 7 and 12 years. Thirteen of the 17 are males and four are females.

As part of ongoing learning, experts belong to professional associations associated with their area of knowledge, and are well-travelled in both Australia and abroad. They enjoy reading both fiction and non-fiction books. They read *a wide range of things* and can be *catholic in...tastes*. Non-fiction formats include *biographies, technical and historical books and science fiction*, and embrace topics from *the corporate world and natural science to architecture or art*. It might be the *sceptics' newsletter* or a *book that's got quirky things about maths, grammar, history*

Regarding fiction, some read *novels, all kinds really*. Some read *purely for entertainment and relaxation* and others read books that encourage reflection, *books that look...at things that face all of us humans*. The novel gives you *insight into other people's view of the world...on human failings*. Whilst most experts like to read, some *don't really have time to read books, are time poor, or don't read books or very, very rarely*.

Experts watch films. They might have *fairly broad taste in film*, or enjoy a *well-made film*. Some are familiar with film genres, from *thrillers or investigative dramas* through to *science fiction and comedies*. Film topics can be *serious, thoughtful, something that's got a story*. They may avoid certain genres. *I don't like comedies...not horror...not action,...they don't appeal to me*. Some like the *whimsical romantic*, and others *don't mind a bit of action or... seeing James Bond. They're fun*. As with books, experts choose films that allow for reflection: *films that make you think...that really challenge the way you think about yourself and your future*. Some prefer a *serious theme...a deeper story line*, or complex situations such as *the workings of the legal system and human side*. Film need not be serious to stimulate thinking: *a lot of good comedy...can be used to create debate and for good*.

When it comes to recreation, experts have broad tastes. Hobbies include everything from *Sudoku and cryptic crosswords* to *bush regeneration, yoga, meditation and dancing*. Preferred sports include *tennis, skiing, cycling, golf, surfing, lawn bowls, and cricket... I love the games within the game*. Not all experts enjoy hobbies: *I'm not very good at hobbies...it's the one big gap in my life. My passion is for my work*.

Experts enjoy family and community activities: *I like being out in the country with the kids and talking to them about...why things are the way they are*. Some volunteer in their local community as a *Rotarian*, at the *local church, the SES*. One expert gains the support of his employer to be a *volunteer of the Yellow Van...(we) take good quality food and supplies to less well-off people*. Here, we see experts motivated by the values of social justice and social inclusion.

Regarding media preferences, experts *read ABC news online, newspapers on-line. It's a good way of getting your news and information*. Experts watch television, listen to a variety of radio and read newspapers. They watch for news programs, with the ABC the most cited source, although some prefer *the more light-hearted...delivering*

news differently...comedians who actually present the news, instead of it being just your Channel Nine News reader. Radio is a very good way of getting information. I'm an ABC radio listener in my car, a community station...and UK stations. Experts try to read newspapers fairly regularly. We still get the paper, I like the feel of the paper. They are a favourite method of gathering information. It's about the world. They select serious newspapers rather than tabloids.

Experts have their dislikes around media. One has *an aversion to the Murdoch press*, and another has a problem with the radio talkback format. *I tend to get a bit annoyed, it seems to wind me up...That's not a good thing.* Here we see that this expert accepts the need to avoid something that can stimulate his negative emotions. Experts display other emotions, for example showing show curiosity and interest about their own domains of knowledge. They like *interesting jobs which from a professional point of view (give) a bit of a buzz.* They like *a real scientific challenge. You're trying to find out how the world works. ...a search for meaning in science.* Experts are open to new knowledge: *I'm always learning new terms and new things. I'm starting to read...about human behaviour, how people go about their day to day and how they react to particular issues. I'm still pretty green in that area but I'm intrigued by it.*

Overall, experts live their everyday lives as others do. Their experience as social beings allow them to appreciate the world that is external to their own domain of experience, understanding and knowledge.

To conclude, I find that:

Firstly, experts are experienced professionals, and are well-educated, well-travelled and can be curious about the world.

Secondly, experts can vary in their choice of news media, and use a mix of traditional and digital media forms.

Thirdly, experts can vary in their level of engagement in sport and community activity, and in their choice of recreational activity.

Fourthly, experts can hold strong views around ethical issues.

Fifthly, experts, as individuals can have capacity to understand, think about, and act in, the social world.

4.3.2. Findings from a focus group. Non-experts' construction of the meaning of 'the expert'.

Non-experts provided their perspectives about 'the expert' in two activities conducted firstly, at the beginning, and then at the end of the focus group. As explained in Chapter Three, focus group participants were non-experts who came from two communities who had, or were experiencing, contamination and remediation of their local environment.

The first activity, Activity One, explored non-experts' construction of the meaning of 'the expert'. Each participant was asked to write down the first thought or thoughts that came to mind about 'the expert'. Responses were collected and the data analysed using thick description, revealing that non-experts allow for positive, negative and ambiguous meanings about 'the expert', or describe attributes about their personality and professionalism.

Table 4.1. below provides a summary of the classifications about 'the expert'.

Activity One Data Classification about 'the expert'			
Conveys a positive meaning	Conveys a negative or ambiguous meaning	Experts as professionals	Experts' Personality
<i>EPA</i> <i>Safety</i> <i>Very helpful</i> <i>Factual</i> <i>Definitive</i> <i>Council consultation</i>	<i>Combative</i> <i>Abrasive</i> <i>Hostile</i> <i>Unpleasant</i> <i>Dishonest</i> <i>Ulterior motives</i> <i>Manipulative</i>	<i>Confidence</i> <i>Remediator has to be honest</i> <i>Able to get a negative message across without being confronting</i> <i>Able to talk in layman's language to the community,</i> <i>Clear</i>	<i>Phlegmatic</i> <i>Lack emotion</i> <i>impersonal</i> <i>Direct</i> <i>Impressive</i> <i>Articulate</i> <i>Wonderfully nerdy</i> <i>A delight to listen to</i>

Table 4.1. Activity One. Data classification about 'the expert'.

The second activity, Focus Group Activity Four followed two hours of group activities. It used a mind mapping exercise to collect data and continued the exploration of the construction of the meaning begun in Activity One. Participants were asked to share their perspectives about ‘the expert’ with the group. Responses were written on a large sheet of paper which was visible to all participants. It contained a circle within which responses could be placed. I explained to the participants that the circle represented the domain of ‘the expert’. Open discussion then took place and was recorded for later transcription and analysis.

Thick description analysis revealed that non-experts position experts as individuals with variable attributes, rather than a group with uniform attributes. On the one hand, experts are seen in either a positive or negative light, or attributes of their personality and professionalism are described. Not all data conformed to these contrasting meanings, and we will discuss why a little later.

Table 4.2 below provides a summary of the classifications about ‘the expert’.

Activity Four Data Classification about ‘the expert’			
Conveys a positive meaning	Conveys a negative or ambiguous meaning	Experts as professionals	Experts’ personality
<i>Trustworthiness</i> <i>Confidence</i> <i>Competent</i> <i>Facts and dates</i> <i>No hidden agenda</i> <i>‘Cool’</i> <i>Holistic, not just from your lens</i> <i>Ethics</i>	<i>Influenced by money</i> <i>Dismiss local concerns</i> <i>Leave questions unanswered</i> <i>Most locals trust RAAF personnel because they are in the community. We are the ‘other’</i> <i>People trust non-experts</i>	<i>Expert is a leader</i> <i>Analytical, smart</i> <i>Crossing, bridging</i> <i>Specialised knowledge</i> <i>Qualifications and experience in the field, age</i> <i>Procedures around the scientific method</i> <i>Which expert, which field of knowledge</i> <i>Local knowledge</i>	<i>Humble, listening</i> <i>The persona</i> <i>Speak as a human</i> <i>Guarded</i> <i>Not guarded</i> <i>No talking down</i> <i>Poised and articulate</i> <i>Appearance</i> <i>Body language</i> <i>Appropriate clothing</i>

Table 4.2. Activity Four. Data classification about ‘the expert’.

At this point, I combine the data sets from Activities 1 and 4 and analysed non-experts' ascription of ambiguous meanings.

The term *combative*, could convey a negative meaning, and in common parlance, it is what this term tends to imply. It might also convey a positive meaning. For example, an expert might choose to be *combative* when defending the credibility of expert risk knowledge when it is being contested by a non-expert who exaggerates the extent of a risk, misunderstands the risk, or confuses risk with hazard. Later, in Chapter Seven, we look at Scheer et al. (2014) and Gregory et al. (2006)'s research which finds that confusion about the distinction between risk and hazard causes communication gaps between experts and non-experts.

The meaning of other terms is similarly ambiguous. For example, *ulterior motives* could be associated with lack of independence from private self-interest, something that research has also proposed, for example Freudenberg (1993). On the other hand, *ulterior motives* could be associated with experts' professional approach during a risk dialogue. An expert might have *ulterior motives* about keeping the dialogue on track in order to maintain focus on the benefits of remediation as well as its risks. The phrase *dismiss local concerns* might be a well-grounded criticism of experts when they ignore or belittle valid concern about a significant risk situation. Such situations are described in the literature, for example by Hillier et al. (2009) and McDonell (1991). Then again, experts might have credible reasons to *dismiss local concerns*, for example when the risk is not significant, but local residents, for a variety of reasons, perceive that it is, and complain or campaign on the grounds that their concerns are being ignored. The literature has proposed such situations, for example Cross (1998).

Overall, I find that the non-experts' construction of the meaning of 'the expert' exhibits variation. Some meaning ascribed to 'the expert' is unambiguous and aligns with literature that associates trust in experts with competence, professional standards, self-awareness and confidence, for example Earle and Siegrist (2006), Gregory et al. (2006) and Hamilton et al. (2006). On the other hand, some meaning ascribed to 'the expert' is unambiguous and aligns with literature that associates distrust in experts with their relationship to private vested interests, for example Beck (1992), Luhmann (1979) and Owens (2000).

Other meaning ascribed to 'the expert' reflects awareness that experts' language can communicate the meaning of something, fail to communicate it, or miscommunicate it. It aligns with Scheer et al. (2014)'s schema which offers an explanation as to why experts from competing domains adopt different understanding of technical terms. Differences result from the particular role of an institution, for example "responsibility for hazard avoidance, economic interest, or a watchdog role" (p.1270). Alignment can also be found with Hamilton et al. (2006)'s research into the attributes of expert judgement, and with Gregory et al. (2006)'s research into the qualities needed for expert risk communication. Further examples of alignment with the literature include Evans and Plows (2007)'s construct of the disinterested citizen, Gustafson and Rice (2019)'s construct of "uncertainty as a message characteristic" (p.2), and research about trust and distrust, experiential thinking and the role of heuristics. (Earle et al., 2007; Siegrist et al., 2005; Slovic et al., 2004; Visschers & Siegrist, 2008).

Table 4.3 below provides a summary of non-experts' construction of the meaning of 'the expert'.

To conclude, I find that:

Firstly, non-experts can ascribe different meanings to the construct of 'the expert'.

Secondly, non-experts can recognise experts as individuals rather than as a uniform group.

Non-experts' construction of the meaning of 'the expert'		
Examples of experts' attributes		
Professional Expertise	Communication Skills	Individual Qualities
<i>Confidence</i> <i>Competent</i> <i>Analytical, smart</i> <i>Impressive, definitive</i> <i>Qualifications</i> <i>Experience in the field</i> <i>Specialised knowledge</i> <i>Procedures around the scientific method</i> <i>Safety</i>	<i>Crossing, bridging</i> <i>Clear, articulate</i> <i>No hidden agenda</i> <i>Not guarded</i> <i>Manipulative</i> <i>Body language</i> <i>Guarded</i> <i>Ulterior motives</i> <i>Money</i> <i>Dismiss local concerns</i> <i>Leave questions unanswered</i> <i>Holistic, not just from your lens</i> <i>A delight to listen to</i> <i>Able to get a negative message across</i> <i>Able to talk in layman's' language</i> <i>No talking down</i>	<i>Trustworthiness</i> <i>A leader</i> <i>Humble, listening</i> <i>Very helpful</i> <i>Ethics</i> <i>Has to be honest</i> <i>Dishonest</i> <i>The persona</i> <i>Speak as a human</i> <i>Wonderfully nerdy</i> <i>'Cool', poised</i> <i>Phlegmatic, lack emotion, impersonal</i> <i>Influenced by money</i> <i>Combative, abrasive, hostile</i> <i>Unpleasant</i>

Table 4.3. Non-experts' construction of the meaning of 'the expert'.

4.4. Findings about time in risk communication.

Time is an all-encompassing concept beyond anything humans can readily comprehend, and also something people are comfortable with in everyday life - the minutes, hours and days of our lives. Although much of life is mundane, there are points in time where memorable events do happen.

Findings about time, as represented by historical events, are generated through in-depth interviews, and the Milestones Questionnaire.²⁰

²⁰ To cite the Interview pro forma, and the questionnaire, go to the appendices for Chapter 3.

4.4.1. Findings from the Milestones Questionnaire.

Findings were generated from the Milestones Questionnaire which required experts to rank milestones according to their relevance to the psycho-social context of pollution. Eleven of the cohort of seventeen experts completed the questionnaire, and to strengthen the analysis, I also included the responses provided by one of the participants in the pilot, bringing the total number of responses to twelve. I used *MS Excel* to analyse and tabulate the survey data, and generated four sets of results. All percentages were rounded.

The first set of results provides ranking of the acceptability of the seventy-four milestones by experts as a group. Of the 74, 51% were fully accepted by all experts, 40% attracted provisional acceptance and 14% were rejected.

For the combination of full and provisional acceptance, the vast majority (85%) of milestones are accepted as relevant by all experts (Table 4.1). The highest ranking (61%) occurred when respondents assigned full acceptability to the seventeen milestones within the third period. The lowest ranking of 10 % for rejected milestones also fell within the third period. Regarding full acceptability as measured for each period; for the first period (1961 – 1978), 49% were accepted, for the second period (1980 -1995), 48 % were accepted, and for the third period (1996-2013), the number was 61%.

See Appendix 4.2. Measures of acceptability of 74 milestones by 12 experts.

Measures of acceptability of 74 milestones by 12 experts				
Ranking	First Period 1961-1978 17 milestones	2nd Period 1980- 1995 40 milestones	3rd Period 1996-2013 17 milestones	Total Time Period 1961-2013 74 Milestones
As a percentage of all milestones				
Accepted	100	229	125	454
%	22	50	28	100
Provisional	66	177	58	301
%	22	59	19	100
Rejected	37	68	21	126
%	30	54	17	100
Unanswered	1	6	0	7
%	14	86	0	100
Total possible responses	204	480	204	888
% Full acceptability	49	48	61	51
% Provisional acceptability	32	37	28	40
% Rejection	18	14	10	14
Measures of full and provisional acceptability	81	85	90	85

Table 4.4. Measures of acceptability of 74 milestones as revealed by a survey completed by 12 experts.

The second set of results provides the measure of acceptability each expert assigns to each milestone. Table 4.5. shows the variation in responses. Some experts show a high level of acceptability and others do not. Nine of the twelve experts fully accept 50% or more of the milestones, with the remaining three allowing 24, 23 and 4% respectively. Two experts give provisional acceptance to 50% or more, with one (IDI 12) ranking 92% as 'maybes'.

As far as rejection of milestones, the highest level was 55%, followed by 39 and 27%, with a good fraction in the middle. One expert did not reject any of them and another rejected one, which again suggests familiarity with the milestones and confidence to rank them.

Variation in acceptability of each milestone by individual experts					
Response as a percentage of total responses					
IDI.	Yes:	Maybe:	No	Other	Total
1	82	15	3	0	100
4	50	11	39	0	100
5	58	38	4	0	100
6	24	20	55	0	100
7	68	4	27	1	100
9	59	31	9	0	99
10	72	27	1	0	100
12	4	92	0	4	100
15	53	42	4	0	99
16	61	35	3	1	100
17	61	32	5	1	99
18	23	57	19	1	100

Table 4.5. Variation in acceptability of each milestone by individual experts.

The third set of results identifies those milestones that attract counts of nine or more from a total of twelve possible counts. Seventeen milestones fall into this category. As Table 4.6. below shows, only one milestone attracts full acceptance by all twelve experts. One milestone attracts full acceptance by eleven, a group of four attract ten counts each and a group of eleven attract 9 counts each.

Rank	Date	Top Milestones (count = or > 9)	Count
1	1998	Community consultation for Homebush Olympic site remediation begins.	12
2	1984	Industrial accident at the Union Carbide chemical plant, Bhopal, India, kills and injures tens of thousands of people	11
3	1978	Federal health emergency declared at Love Canal, New York State due to community exposure to dioxins.	10
3	1997	'Dioxin classified as a known human carcinogen by the IARC .	10
3	1999	NSW EPA issues license for destruction of POPs wastes at Homebush Olympic site.	10
3	2000	Homebush Olympic site remediation completed.	10
4	1976	Industrial accident in Seveso, Italy, causes community exposure to dioxins.	9
4	1984	UN publishes "Consolidated List of Products whose consumption and/or sale have been banned, withdrawn, severely restricted or not approved by governments". List includes POPs insecticides	9
4	1986	Exxon Valdez oil spill in Alaska and chemical spill on the Rhine River in Europe attract international media coverage	9
4	1989	Homebush site remediation project begins [Sydney]	9
4	1992	ANZECC/ NHMRC release Australian and New Zealand Guidelines for the assessment of contaminated sites	9
4	1993	Sydney wins hosting rights to Year 2000 Summer Olympic Games. "Green Guidelines" identify land remediation as a key deliverable	9
4	1993	Master Plan for the development of Homebush Olympic site released: includes broad-acre land remediation	9
4	1996	Community consultation on HCB waste stockpile at Botany, NSW begins	9
4	1998	NSW Government implements fishing bans for Sydney Harbour and tributaries.	9
4	1999	Aust. Govt. introduces first National Environment Protection Measure for contaminated site assessment	9
4	2013	Australian Government introduces amended National Environment Protection Measure for contaminated site assessment	9

Table 4.6. Top seventeen milestones identified by twelve experts.

The fourth set of results identifies those milestones that attract counts of three or less from a total of twelve possible counts. Fourteen milestones fall into this category. As

Table 4.7. below shows, the very bottom milestone attracts acceptance by only one expert.

Rank	Date	Bottom Milestones (count = or < 3).	Count
1	2005	UN launches <i>Globally Harmonized System (GHS) for the Classification and Labelling of Chemicals</i> .	1
2	1968	Club of Rome formed to publicise environmental degradation	2
2	1986	<i>US Emergency Planning/Community Right To Know Act</i> passed.	2
2	1983	U.N. General Assembly creates the World Commission on Environment and Development.	2
2	1972	Australian Environment Council formed.	2
3	1972	Club of Rome publishes <i>The Limits to Growth</i> .	3
3	1972	Colour television introduced	3
3	1981	Soil contamination in Lekkerkerk, Holland linked to human health risks.	3
3	1987	Australian Agricultural and Veterinary Chemicals Council established to harmonise pesticide control	3
3	1986.	Northern Territory Government proposes high temperature incinerator to destroy Australia's hazardous waste stockpiles	3
3	1987	Publication of <i>Our Common Future</i> by World Commission on Environment and Development.	3
3	1991	Wingspread Statement of Consensus provides international scientific recognition of the impact of POPs on the endocrine system of all species studied	3
3	1998	Aarhus Protocol provides template for international POPs control framework	3
3	1999	Belgian 'dioxin affair' reveals food contamination	3

Table 4.7. Bottom fourteen milestones

See Appendix 4.1. Seventy-four milestones grouped by count.

What can we reasonably infer from these results? Here we use the results of this quantitative analysis to inform a second stage of analysis. This involved qualitative analysis that explores what these rankings might reveal about experts' awareness of the wider, psycho-social and socio-political context of pollution.

Quantitative analysis indicates variation in the acceptance of milestones by experts. The vast majority are accepted as relevant by all experts which indicates their

awareness of them. Most experts fully accept 50% or more milestones, and two experts give provisional acceptance to 50% or more. The highest provisional acceptance ranking is 92%, and this ranking is well ahead of what all other experts ranked as 'maybes' and for this reason, it can be considered an outlier. Provisional acceptance of milestones suggests a lack of familiarity about an event or situation, or the experts' preference for a cautious approach. Overall, I infer that experts vary in the strength of the association they make between milestones and the wider context of pollution, with preference for some familiarity to be mainly in play.

Regarding the classification of the top seventeen milestones, all but two are associated with POPs, be it POPs themselves, or associated situations around land contamination, land remediation, regulation and consultation, and hazardous waste destruction. The outliers are Bhopal and the Exxon Valdez oil spill, and here we might be seeing the influence of high media visibility.

As to the fourteen bottom milestones, all but one are remote in place and time, occurring at or before 1998, and most are associated with events or situations in international, or other national jurisdictions. Only three milestones specifically concern Australia and all three happened more than thirty years ago. Again, we see lack of familiarity in play, as well as lack of relevance regarding the experts' situation.

The bottom milestone that is entirely external to experts' domain of knowledge is the introduction of colour television in 1972. As with the other low ranked milestones, I suggest that there is a lack of interest in, or awareness of the impact of this event. In short, it does not appear to be within the mental remit of experts. This reasoning might also apply to the low ranking that experts assign to milestones about international institutional responses. International proclamations, plans and guidance are far removed from the situations that experts have to manage, and as revealed in later chapters, experts appear strongly focused on physical situations where pollution risk is in play. Experts might consider international institutional responses ineffective, too prescriptive, or just not applicable since it is national and state policy and laws that mostly frame their activities. There are exceptions though, and it is worth noting that the promulgation of the Stockholm Convention (UNEP, 2002b) is not without acknowledgement, ranking equal 5th with 8 others of the seventy-four milestones. This may reflect their familiarity with the convention, since once in place, it forced change

in the extent to which POPs were remediated, and this created opportunities for industry.

To conclude, I find that:

Firstly, experts can recognise milestones when they are associated with their areas of expertise, or when they suggest values that align with their private values around justice and human rights.

Secondly, experts can lack interest in, or awareness of, events and situations that occur in national or international jurisdictions.

Thirdly, experts can associate milestones with the psycho-social and socio-political context of pollution.

Fourthly, experts can retain a memory of pollution which contributes to their understanding of psycho-social context of pollution.

Let's go now to findings about milestone events that emerge from the in-depth interviews.

4.4.2. Findings from the in-depth interviews.

During interview, experts mention events and situations, some of which are milestone events, and others are events which are also associated with pollution and its remedy. All events were classified as either milestone or associated events, and analysed using thick description.

Sixteen of the cohort of seventeen experts mention milestone events, including Bhopal, the Vietnam War and the use of *Agent Orange*. They mention the contaminated community of Love Canal as a place where pollution was made visible by *the arrival of black ooze in people's basements...there was something buried there that shouldn't be*. Experts mention contamination in Sydney, NSW, including at Homebush Bay and adjacent Homebush Olympic site, as well as a POPs waste stockpile in Botany. Regarding milestones associated with remedies to pollution, experts mention the Stockholm Convention, or allude to the release of the United Nations list of banned and restricted products (United Nations Secretariat, 1984). They mention the feature film *Erin Brokovitch* that leaves *a lasting influence in the back of*

people's minds. One expert considers the film contributes to public awareness about pollution. She remarks:

People only understand the high profile, high impact, high risk incidents and they understand them through films like 'Erin Brokovitch'. I know that because every time that I say I work in remediation and someone actually understands what remediation (is), that is mentioned...more than 90% of the time. They either understand that way, or through a high profile (event) like the Bhopal disaster.

Experts ascribe meaning to milestones when they provide a normative perspective around excessive or involuntary risk. Bhopal involves a *tragic release* of gas. The use of *defoliants in the Vietnam War* (is) a *shocking indictment on the Americans and their allies*. The expert making this latter judgement provides a humorous touch around the practicality or otherwise of a fishing ban put in place due to the *disgusting* condition of the sediments of Sydney Harbour. He quips that the situation is *at the point now ...where...no fish caught west of the bridge (can) be eaten... How the fish know to not go to the other side of the bridge, I can't quite understand*. In saying this, the expert implies that regulation may be inadequate to protect public health, and another expert agrees, mentioning other *chronic risk scenarios where governments could avoid making decisions by claiming that the exposure did not pose a significant risk*. On the other hand, experts understand that governments can support activities that reduce pollution risk if it is *done the right way*.

Experts provide meaning to milestones by a providing a temporal context to the risks they might pose. They refer to *a lack of disclosure over the years*, or *the legacies at Homebush from Union Carbide*. In the *early days in understanding...the remedial methods...used at that time probably wouldn't be allowed now*. The Stockholm Convention provides support for a technology, *which...was quite new at the time for Australia*.

Milestone events can trigger memory. An event can *for some reason...jump into the mind*, or be prompted by something *high profile and spring... to mind*. When an expert reads *Silent Spring* by Rachel Carson, she recalls *news coverage ...people were going down off the back of a Ute and spraying pesticides over people*.

Thirteen of the seventeen experts recall other events and situations, including in Australia, for example atom bomb tests at Maralinga,²¹ waste incineration in Sydney, lead, zinc and asbestos mining, and ground and surface water contamination. They also recall events that occur in other nations, including at Flixborough in the U.K., and at Hiroshima, Nagasaki ²² and Minamata in Japan.

Experts ascribe ethical meaning to situations where there is excessive, involuntary risk. At a waste incinerator, there are *a lot of...dioxin emissions...It was uncontrolled combustion...That incinerator was very poorly operated*. A smelter releases lead-contaminated emissions that causes *a significant number of children* to be *under-delivering intellectually*, and the *ingestion of fish* causes children from Minamata to become paralysed, unable to communicate and with shortened life spans. Involuntary risk is reduced when *the company and the government paid a fortune to have lead vacuumed out of house ceilings*, but children in other situations are not so lucky because they live in *communities (that) have been exposed to emissions*, (involving) *chronic exposure at a level that government would say is not a significant risk*.

Involuntary risk is again suggested when an expert is *remind(ed)...of the James Hardie asbestos lack of disclosure*. ...*They were so willing to put their employees and the public at risk*.

Regarding voluntary risk, an expert mentions a current situation around asbestos contamination in Australia where *they've tried to seal the town off...but there's a number of people...firm in their belief that their exposure has already occurred, so they'd rather stay there*.

Experts mention events and situations that align with their professional interest and sense of responsibility. Gasworks provide *very interesting aspects to...industrial site history*, and there is an *industrial disaster* when *hydrocarbon gases...ignited ...and killed a lot of people*. That event was *the tipping point...led a lot of the development of .. principles and tools...flowed down through* the company in Australia. The context here is around change to a corporate culture, extending out from shareholder value to

²¹ The British Government tested atomic bombs in several parts of Australia, including at Maralinga. Milliken, R. (1986). *No Conceivable Injury*. Penguin Books Australia Ltd.

²² The two cities where the first atomic bombs were used at the end of the Second World War

the health and safety of employees. It could be as Beck (1992) allows, a reflexive response in the form of “*switch settings for alternative social futures* which would connect the realms of industry, research, politics and law” (p.179, original emphasis).

Staying with improvements, an expert notes the increase in biodiversity in Sydney Harbour due to the ban on a pesticide: *The last boat builders tell me in the past few years the water now is clean as when they were kids.... Their barometer is the blue mussels that have returned to the mooring ropes... ..that relates...directly to the closure of ‘Cockatoo’²³, where I’m imagining copious quantities of...TBT were used.²⁴*

To conclude, I find that:

Firstly, experts can recognise key events and situations, including milestone events.

Secondly, experts can understand that there are ethical implications when people are exposed to excessive or involuntary risk.

Thirdly, experts can understand that there is a temporal context to risk.

Fourthly, experts can understand the psycho-social and socio-political context of pollution.

An established scientific institution alludes to the wider context of pollution when referring to “the origins and dynamics of...controversies”, and proposing that better understanding of them “will be necessary if science communication is to be more effective” (National Academies of Science Engineering and Medicine, 2017 p.6.). Here, we see acceptance that past pollution events can confound risk communication, so let’s now consider the time issue by exploring experts’ awareness of the lags between pollution recognition and pollution regulation.

Experts are aware of time lags, including around *Agent Orange*, *PFCs* and *fuel depots and asbestos*. Regarding asbestos, *we knew long before proper measures were put in place that this stuff was dangerous...Legislation (had) not...caught up a lot of the time. There is always that lag. It has been known about by the government for many*

²³ A former ship building and repair naval facility in Sydney Harbour, NSW

²⁴ TBT is tri-butyl tin. It is an inorganic pesticide used as an anti-fouling agent on boats in Australia. It was banned in 2003 by the International Maritime Organisation.

years. It wasn't acted upon adequately or early enough. We started to understand the risk of exposure...We then had to bring in environmental legislation. Experts are aware that what was acceptable in the industry many years ago now (attracts) zero tolerance. They understand that there were no guidelines on what was an acceptable risk and that standards may have changed.

One expert alludes to Van Asselt and Vos (2008)'s "uncertainty paradox" when he identifies the critical issue of standard setting under conditions of uncertainty. As he explains it, *each time a new scientific study was fed into that system about the physical risks of a particular element at a certain concentration, it effected definitions and standards. As a result, governments are obliged to put proper measures...in place and spend...a lot of money.*

Now spending money to better address risk can involve implementing more stringent exposure standards, and one expert explains this process by referring to a well-accepted risk: *cigarettes and smoking is a key example where, over time, there's a greater awareness and understanding of what the real issues are. In this situation, the risk standard is adjusted upwards to improve public health protection by limiting exposure to the hazard (tobacco). However, experts understand that it is not always about tightening standards. Standards can be adjusted downwards if new, credible knowledge is available. For example, information coming through suggests that we need to have another look at the lead numbers...When you don't have enough information there is a degree of old factors of safety (being)...applied. Once those things are better understood, there is relaxation of levels.*

Experts understand why time lags occur. They explain that in the past, there was *not much rigour... and over time the regulator has recognised we need to be a bit stronger on properly assessing those sort of things.* Experts explain lack of *rigour* in terms of lack of capacity. For example, *back in the '90s...there was no capability to service their environmental remediation requirements. There weren't really courses related to contaminated land. An expert explains that consultants tended to lead the way in how things were done.... Back in the day...the company...was making scientific instruments...trying to measure things that nobody else was measuring...The knowledge of the effects on your health was the driver, with the whole realm of*

environmental management and decision...fast growing and fast moving...With that comes increasing regulation and part of that is standards.

In this last example, we see that experts understand that time lags have been addressed with respect to some well-established pollutants in some jurisdictions. Experts are also aware of emerging pollutants such PFAS which remain waiting for resolution. *We've newly found that there's a lot of it around...They weren't really recognised five years ago, now they're becoming front and centre. It is going to be a problem in the near future.* One expert sees an ethical dimension around exposure to PFAS when she asks *why should we be allowing...chemicals like these to be used unless they're proven to be safe.* Situations like these are examples of what is known in the vernacular as 'the long tail'. Edelstein (1988/2004) describes it as "the mitigatory gap...the time that passes between when the exposure is discovered and the determination and execution of corrective steps" (p.168).

To conclude, I find that:

Firstly, experts recognise that technological changes over time govern the level of empirical uncertainty associated with pollution risks

Secondly, experts recognise the ethical aspects inherent in the time lag phenomena.

Thirdly, experts can understand the psycho-social and socio-political context of pollution.

4.5. Emergent overall findings: *The persona of the expert.*

Findings from the in-depth interviews demonstrate that experts display various attributes in different measure, according to their individual approach. They can be well-rounded people, understand something of how the world works, be curious about the world, and have diverse personal interests and lifestyles. They can have knowledge about how their industry developed in response to the harmful impacts of past pollution. They can retain memories about pollution events and situations and can recognise that there are ethical tensions and competing values in play between groups, be they experts, non-experts, government or private commercial interests. Experts can appreciate that public, private and company values influence the way their

industry operates and how it is regulated. Overall, these attributes allow experts to have some understanding of the wider context of pollution.

Findings from a focus group of non-experts show some alignment with those from the in-depth interviews mentioned earlier. When non-experts construct the meaning of 'the expert', they allow for ethical tensions, public and private values, corporate responsibility, confidentiality, and for the idea of 'the expert' as an individual.

At this point, I can introduce an emerging construct which I name as *the persona of the expert*. It aligns with Slovic et al. (2004)'s schema of two modes of thinking which allow for the co-existence of analytical and experiential processing of risk knowledge. I will continue to explore *the persona of the expert* in later chapters.

To conclude, I find that:

Firstly, experts have some capacity to apply both analytical and experiential states to their understanding of risk and risk situations.

Secondly, experts can understand the psycho-social and socio-political context of pollution.

Thirdly, experts can display a set of attributes that contribute to a particular type of *persona*.

Let's now apply the findings to the first research question. It asks for evidence of expert content and processes that can bridge gaps in knowledge and understanding between experts and non-experts who participate in social engagement processes.

In this chapter, I find evidence of experts' capacity to understand the wider context of pollution. By recalling and understanding the impact of historic pollution events and the reforms that followed, experts can appreciate reasons why non-experts can have different perspectives to them about a pollution risk. They can understand non-experts as 'the other' because they experience the same physical world as them. They can recall risk events and situations and position them within a social, as well as a scientific frame. They can understand conflicting value forms and contested knowledge around risk, and can be familiar with ethical issues around risk and values.

Ensuing chapters provide other findings that address the research questions, but before we leave this one, there is a finding about experts' colour preferences. It is blue, by a wide margin. They have a *blue prejudice*, described by one expert as *nice and conservative*. What is meant by conservative here? It could be a reference to experts' political preferences, the way they think, or something else. We cannot know, but drawing on Stretton (2018), I will venture an explanation. He allows that "some important facts are hard to know for certain... (M)ost understanding of what causes what in particular cases calls for some imagination as well as hard knowledge" (p.283). What we do know is that experts, when they are scientists, are trained to be conservative in their interpretation of evidence, and that when they use the word 'conservative', its meaning is specific. 'Conservative' for the expert applies to the lowest achievable level of risk. It is 'conservative' in that it is highly precautionary being, as one expert explained *the upper-bound limit of risk*. However, it might be that when experts use this scientific term in a public setting, it could be interpreted by others as meaning the opposite. In current political dialogue, the word 'conservative' can take on a negative meaning when used by groups that identify as 'progressive'. These general terms are rarely well-defined, and, for example had very different meanings in the nineteenth century (Stretton, 1969). The question then is whether extended meanings of a term could confound effective risk communication. We explore this possibility in Chapter Seven, Section 2.5. when we analyse the use of the word 'toxic' in the mass media, but at this point, let's go to the next chapter and see how experts address the issue of uncertainty.

Chapter Five. Analysis and Findings:

Uncertainty.

This is the second of five chapters that present the findings of the research project. It presents the findings about uncertainty.

Uncertainty is a constant for human experience and has different meaning within different knowledge domains. For this inquiry, its meaning is associated with lack of scientific information about the risks posed by exposure to contaminants, or differing risk levels associated with their remediation. Tension between different epistemic groups can arise when uncertainty is operationalised through a decision-making process that requires the conscious selection of risk settings.

5.1. Uncertainty as represented in the literature.

For this inquiry, uncertainty is associated with unknowns resulting from assumptions made about the properties of hazardous chemicals, and variability of knowledge about their toxicity and exposure potential. For the Commonwealth of Australia (2012), it is these factors that can lead to “uncertainty in the estimates” (p.22). In this case, it is uncertainty in its empirical form, but as we have seen in the literature review, there are two types of uncertainty, empirical and perceived.

Empirical uncertainty exists in the physical world, described by Gustafson and Rice (2019) as an “epistemological fixture”. (p.2). Estimates of uncertainty are made in scientific domains using statistics, probability and decision analysis (Tulloch & Lupton, 2003; WHO Europe, 2004; WHO/UNEP, 2013). When estimates emerge from these formal assessment methods, they create a weight of evidence, which, as one scientific institution proposes, translates to “risk”.(National Academies of Science Engineering and Medicine, 2017, p. 89). In this schema, “risk infers potential or possibility about something happening in the future, and although it can be predicted with some accuracy, there are always unknowns (National Academies of Science, 2015, p. 8). For Luhmann “uncertainty ..is bound to exist. The future places an excessive burden on man’s ability to represent things to himself. He must therefore prune the future so as to measure up with the present – i.e. reduce complexity.” (p.13)

Explaining the extent of empirical uncertainty can be difficult. Driedger (2008) finds that health professionals are unable to explain on the one hand, that there is uncertainty around health outcomes associated with chronic exposure to chlorinated water, and on the other, that the risks are not significant. Here we see Van Asselt and Vos (2008)'s uncertainty paradox in play. The paradox goes to the heart of the issue as to why there can be gaps in understanding between experts and non-experts. People in the latter group can struggle to accept scientific evidence around risk selection, since it can only ever provide provisional proof that something might, or might not occur. They can find it difficult to understand that scientific truth is contingent truth in the sense that it is contingent upon falsifiability.

When non-experts consider an empirical risk which could impinge adversely on their health or livelihood, they might recall situations and experiences to help them understand the potential for harm. They will be uncertain about the extent of possible harm, and it is in this sense that perceived uncertainty is created in the mind by a person's individual experience, emotions and memory. Gregory et al. (2006) and Botterill and Mazur (2004) propose this, and Sword-Daniels et al. (2016) also allow for uncertainty in both the material and mental world. They position objective uncertainty around "natural hazards" and embodied uncertainty around a state of consciousness, the "internalization at the individual level, where it is subjective, felt and directly experienced." (p.1. Similarly, Taylor-Gooby and Zin (2006) allow a role for experience and emotions when they refer to "situations of high uncertainty..., (and) greater uncertainty in the life course" (p.402-405). There is merit in this approach in that it aims for "a more sophisticated understanding of the way in which the cultural context influences the apprehension of and response to risk" (Taylor-Gooby & Zin, 2006 p.407.) However, over-emphasising the cultural context of an empirical risk might create difficulties for non-experts who are trying to understand the degree of risk presented by a given situation. Greenberg et al. (1991) for example, describe situations where there is controversy about technology risks and political or economic forces are strongly in play. Such situations make it difficult for a scientist to "communicate uncertain results to audiences with limited scientific knowledge" (p.247). Similarly, Van Asselt and Vos (2008) observe that "the presence of uncertainty challenges, or at least complicates, the role of experts as risk assessors." (p.282) Bardos (2008) addresses the uncertainty issue by proposing the development of decision support systems for

contaminated land assessment and remediation. However, like Greenberg et al. (1991), he concedes that when scientists try to resolve empirical uncertainty to the satisfaction of “all stakeholders (it) can be difficult. Dealing with uncertainty is perhaps the most contentious area in the use of decision support. (p.55)

At this point, we can understand some reasons why risk communication by experts can be difficult when both empirical and perceived uncertainty are in play. Inevitably tensions arise around competing constructs and definitions which makes communicating technical complexity and the meaning of probability to non-experts very challenging.

Let's go now to findings about uncertainty from the in-depth interviews with experts.

5.2. Findings about empirical uncertainty and risk calculation.

You can't call it unexpected because you kind of expect it. It is what you don't know. Remediation expert.

During in-depth interviews, experts were asked specific questions about the meaning of uncertainty. They were asked if they routinely encounter techno-scientific uncertainties during remediation situations. If they did, they were asked whether the uncertainty is constant or changeable. If there was change, experts were asked why. Experts also provided other perspectives around uncertainty.

Experts are aware that empirical uncertainty is a constant in remediation situations, including around site characterisation, hazard and risk assessment, project management, technology performance and validation processes. Experts position uncertainty around *the empirical situation and the environment*. It's *part and parcel of what we do*, it *impacts on...people*, *how the body might be experiencing those impacts*. Experts' strongest suite is around understanding the uncertainty inherent in site conditions. There is *geological uncertainty and latent conditions ... A particular chemical was completely unexpected*. Unknowns are *quite often buried; you don't actually know what's down there*. There is variability in uncertainty because of *heterogeneous materials*. There wastes that contain *eight different contaminants, which behaved differently under different conditions*. Uncertainty is around *unknown*

unknowns, as occurs in the case of hydrogen in soils where there is no knowledge...rather a gradual revelation.

Experts recognise *uncertainty around the total volumes. You could put a thousand boreholes in and you still might miss something.* What is missed is important since it might indicate a greater risk than is initially calculated. In this regard, *you can do as much testing as you can...and you may still come across something that's unexpected...hot spots of something that was not deemed to be a major contaminant...and lo and behold, there it is. You think you understand everything and something happens and you realise, hang on, we thought there was no issue there, where all of a sudden you find dioxins.*

Experts account for the *unexpected* by applying *a hierarchy of the methodology, understanding toxicology, doing calculations in risk assessment, or bringing in uncertainty.* Regarding calculations, experts are clear that uncertainty can be *statistically derived, or calculated around frequency or probability when the numbers tell us the story,* but others recognise that calculating empirical uncertainty involves more than getting the numbers right. *Risk assessments are built around conservative and empirical processes. (There are) limitations...and underlying assumptions which require sensitivity assessment...Matching independent and dependent variables...(is) still pretty hit and miss. They are semi-quantitative...not..quantitative results.* Here we see that experts can make a conscious selection of a risk level that is protective of human health. It is a level around the *upper bound risk, and is derived by taking into account uncertainty, and putting in some conservative safety factors to err on the side of caution.*

One expert proposes that cooperation between different types of experts improves the characterisation of uncertainty. *You have the engineers with the slide rules and the decimal points and you have the geologists with the three-D pictures and the uncertainty, and you need to put both bits together to make it work, to get a better solution.*

An expert points to the selection of risk levels using economic and planning parameters. *For residential use we want to be 95% certain that we've got it right...perhaps for open space land use or commercial use you can be a little less certain.* Another expert alludes to the tension that can arise between economic self-

interest and a values-based approach to uncertainty. Given the need *to deal with the unexpected*, he asks: *where is the uncertainty? What way...should you take...responsibility...from a contracting point of view?* The issue here is whose interests prevail where risk levels around contamination are directly connected to the cost of its remediation. This is understood by Gregory et al. (2006) who understand that there are “profound uncertainties that ...leave room for different interpretations based on stakeholders’ trust and perceptions of scientists’ credibility.” (p.718) Similarly, Botterill and Mazur (2004) find that “the calculation of probability is not a value-free activity” (p.4), and credibility is an issue for Flage et al. (2014), since the crucial risk measure of probability “cannot be made unconditional” (p.1204).

Experts understand that uncertainty calculations change over time. *History is littered with underestimating risks based on lack of knowledge. Every one of those areas of uncertainty...have changed in 20 or 30 years.* An expert recalls that *over a period of five years that technology...changed dramatically...Subsequently ... we had capacity to measure even to a greater level.*

Another limitation that can lead to uncertainty is around contaminant sampling. *Uncertainty sampling and investigation programs are exceedingly complex, and if you don’t collect...samples that are representative...the rest doesn’t really matter.* For industrial air pollution, *emission factors are not well characterised... (There are) unexpected sources of emissions. People often don’t take this into account when they’re doing assessments.* Sometimes, characterising samples of contaminated media can be difficult, including *working out what was in the dust.* The same limitation applies to contaminated air in that *instruments won’t measure ...concentrations that you can smell in sub-parts per billion level.*

Another limitation around sampling is its frequency. It seems logical that increasing the number of samples will improve predictability, but this might not be the case, and if it is not, there can be unexpected consequences. One expert explains this type of situation: *Someone...takes a sample, then the lab might take a small sub-sample of that ...Is that representative of the material in the jar? A lot of emphasis is placed on that laboratory result when it can be quite different, particularly...heterogeneous materials like fill.* (There is) *a lot of variability and people don’t appreciate that...You*

commonly see some elevated results...They end up digging up the whole site. There could have been more consideration of the uncertainty.

When sampling is taken on face value, it can increase uncertainty. *People just believe results...They don't really think about those results enough. People...say it's below criteria. There's a lot of uncertainty around that.* One expert considers that in the U.S.A., the sampling regime is better because *the US EPA tries to make you address uncertainty (through the use of) the data quality objectives approach.*

Experts express their opinions about *new uncertainty* around analysis of PFAS compounds.²⁵ Some are frank when they state that *various organisations are coming out with their views...That drives uncertainty*, or explain that analysts are *still debating what standards to calibrate their instruments with.*²⁶ There is also uncertainty about what a laboratory result means, for example a result about the PFAS known as PFOS. *For PFOS in blood there is a much better understanding, much reduced uncertainties in cancers...We actually now realise we haven't necessarily measured the right contaminant.* This situation presents the expert with an ethical dilemma, since when the new PFAS are measured, experts are *wondering what to do with this information.* One expert understands that *the toxicology around perfluorocarbons is not clear. The risk models are largely animal based and ... developmental effects in animals ...are not well understood in humans. Applying a conservative and reasonable toxicological approach to perfluorocarbons in risk assessment was very challenging. We don't really understand the true risk.*

Experts note a similar challenge around the uncertainty inherent in remediation situations. They refer to *those unexpected finds and occurrences*, or invoke the *Mr. Rumsfeld analysis, his known unknowns.* Experts are *quite good at dealing with the known knowns, and we're pretty good at dealing with the known unknowns, but we don't have good systems for dealing with the unknown unknowns. No matter what type of unexpected thing, it...will always decrease people's comfort level...might upset people or raise doubts...something that they hadn't predicted.*

²⁵ PFAS refer to a group of perfluorinated substances. See Glossary for definition.

²⁶ By 2019, this situation had been remedied.

This brings us to uncertainties associated with data used to calculate risks to public health. Health risks can be *based on methodology...that didn't measure those ultra-fine particles*, or did not account for *lack of understanding of...the effects...of the chemicals*. Experts understand that *some parts of the population seem to be more affected by some of the different items*, which might go some way to explain why people complain *about...a Remediation Action Plan...there's data gaps*. Siegrist et al. (2007) connect data gaps with information uncertainty, noting that there is insufficient recognition of its role as a crucial moderating factor around the judgement of fairness. Flage et al. (2014) does the same, alluding to, but not directly calling out, the issues around lack of transparency of data and its variable quality. They refer to “uncertainty factors that are ‘hidden’ in the background knowledge” (p. 1203).

The technical complexity of remediation situations contributes to uncertainty, for example when *you've got maybe 50 or 100 chemicals in the ground*. They point to the uniqueness of the uncertainty inherent in their industry as compared to *construction and civil projects*. *Uncertainty...is greater in a remediation project than in a typical project, where uncertainties are very tightly controlled (and) costs are very predictable*. In contrast, for remediation situations, the extent of scientific uncertainty is so great that the normal approach to pricing has to be stood on its head, with more front-end allocation of costs to ensure that the uncertainty is sufficiently well characterised. However, there are situations where clients, particularly developers, *haven't really come to grips with defining the problem sufficiently to get the certainty they want in the solution*. It's *one of the historic complaints from clients...If you compare the estimate to the actual cost, ...the cost is much greater than the estimate*. This can be problematic for *people in a commercial environment (who) are always going to try and minimise the cost*.

One expert is frank about the need to change this situation: *Dealing with stuff under the ground creates a lot of uncertainty, technically and financially and it is important for whoever is funding the work ... to realise ... what we know is what we know, and what we don't, we don't know.... Contingencies are too low...(It) needs to be more than just the usual 10% ... They need to actually spend more money on the front-end to reduce the uncertainty*. There is *too much optimism in the way people budget to do the work. They should budget for more uncertainty, and price more accurately*. Here, experts recognise a clash between the objectives of the risk owner and the risk

remediator. A client *started building before the contamination studies had been finished*. The project was *much more drawn out than if remediation had been done prior to the start of any construction*. Now whilst clients, particularly developers, may not understand uncertainty sufficiently well, neither do some experts. *Some have very good grasp of uncertainty, some have not such a great understanding*. It is *not consistent across the industry*, and *if you don't understand uncertainty, then you really can't be objective and a good professional*.

Lack of knowledge or concern about uncertainty brings into focus the need for technical training, and some experts are scathing about its shortcomings. *It is appalling that someone would be sent...to site and not know those things*. *Computer programs...calculate statistics ...(are) almost laughable in their output...It's like firing a shot gun at it, and the kids that are putting them into the program don't know what it means*. Another expert refers to the lack of *formalised training programs...in many consultancies, including a failure...to use professional statisticians*. This situation may go some way to explain why *people today...don't know how to properly assess the uncertainty of the measurements that they are taking, preferring to just believe results*.

Experts play different roles during a remediation project and have different approaches to uncertainty and the risks it gives rise to. Auditors for example, tend to prescribe very high safety levels, and experts who are responsible for delivering a remediation contract can be critical of them because they *might not ..understand the economic drivers*. *The auditor says...do these series of activities*, but from the point of view of the remediator, *if an auditor is not cognizant of that fact that what he is doing is really impacting the time...then there needs to be something around that*. An expert who is an auditor explains that he is obliged to see uncertainty from a scientifically conservative perspective to make *sure that process complies*. *Being an auditor you become more aware of the uncertainty...has to go almost beyond that*.

Regarding compliance, experts frame uncertainty around politically charged situations when governments are obliged to respond to emerging social agendas. When discussing the management of public expectations around a high profile remediation situation, they express both frustration and political savvy: *More uncertainty is introduced from external stakeholders*. *The EPA may demand something that is possibly unreasonable.... They can introduce things that are not required technically,*

but maybe are required politically. In this situation, compliance levels are impossible to achieve. There were a number (of dioxin emissions), and the reality was they put limits that were not measurable at that point in time. The exercise was to make sure that the Olympic Co-ordination Authority could not meet the targets, because we'd pissed so many people off with our single minded process of getting the Olympics to where it had to be.

Now impossible compliance levels are one thing, and impossibly conflicted regulations are another. For example, at State level, there are *lots of EPA...guidance documents and part of the challenge ...is resolving their conflicts...because they're not all consistent*. One expert points to a conflict situation around infrastructure development when a NSW government department is required to deliver tunnels to address politically damaging traffic congestion, and another is charged to regulate this process by addressing the risk of contamination of the environment. The tension between these two objectives is apparent to one expert who understands contamination problems associated with tunnel development. *All the tunnels are putting groundwater plumes around in the metropolitan areas, or potentially doing so...They are digging up acid sulphates, asbestos and goodness knows what*. Similarly, at national level, we *don't have a harmonised approach around the NEPM²⁷ and waste guidelines*. There is *one set of guidelines for a compound in the soil but when it leaves the site it becomes a waste...(and) there's another set of guidelines...Same company in a different state...a different set of guidelines...Some of the interpretation around that can sometimes cause uncertainty*. To remedy to these inconsistencies, an Australian Government program has developed a national remediation framework (CRC CARE, 2020; NRFSG, 2014).

To this point, we have seen how scientific uncertainty plays out in remediation situations. Now we turn to ways that *the design for remediation project* can reduce it. For example, experts can apply *good conceptual models* where there is *the application of geological thinking ...When you want to dig sites up, (you need to) have an understanding as to what might happen*. Experts refer to a *whole-of-site* approach to *the investigation side of things*, or an understanding *where all the data gaps are*. *It's collaborative.... a multi-disciplined team*. They *examine every line in the whole job and*

²⁷ NEPM refers to a National Environment Protection Measure.

every instrument. Using new measurement technologies improves such understanding. *Really accurate field based measurement* reduces uncertainty through *sufficient characterisation*, and getting the *exposure component* right. Experts appreciate that instrumentation *is a lot smarter and computerised*, gives more *reliability and responsiveness and prompt action*, allows for more detailed measurements, more precision...*You can set it and forget*. It's an *incredible improvement...get results whilst you're on site (is) more important than getting results after you've demobilised*. You don't have to have this lag while you wait for data to be processed. Heberle and Wernstedt (2006) find the same when they refer to "an increase in technical knowledge about environmental assessments and clean-up and containment practices" (p.4900).

Improved measurement technology reduces uncertainty around *established known toxic substances*. For example, for *dioxins*, uncertainty around them is *reducing...because you've got better accuracy in understanding potential exposure*. However, as one expert observes, increased knowledge can bring increased uncertainty: *We've improved on one side...(and) we've created more questions on another*. With the *emerging chemicals*, the uncertainty around them is both *increasing, while at the same time reducing*.

Some uncertainties are beyond the power of experts to manage. There is *inclement weather*, or *uncertainties...around with suppliers...Each job has its...site-specific conditions which create issues*. Experts understand the need for *good company project management*. A *logical path* is required to select a *level of uncertainty*. For example, there are *rules about processing risk, or management plans..(that) deal with contingencies and unknowns*. You would have a *protocol for unexploded ordnance or drummed chemical waste*, an *unexpected finds protocol*, or a *universal stop work authorisation*. If you discover something *unforeseen*, you *stop works*. Here we see alignment with Gregory et al. (2006)'s understanding of *decision-making under uncertainty*. In this schema, "it is an iterative process rather than a one-off exercise" (p.261).

When experts stop works, they do so because they anticipate that a risk might be in play and in this way, they are guided by the *precautionary principle*. It states: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not

be used as a reason for postponing cost-effective measures to prevent environmental degradation” (United Nations, 1992, p.3). In other words, people need to take action to prevent future harm, despite there being insufficient evidence of harm. One expert refers directly to *this precautionary principle... (It) says if we...don't know what it is...we shut down and put in place a safety system, then seek expert advice from somebody...and come up with a solution for it .*

In this type of situation, uncertainty is acknowledged and can be addressed, including through *engineering controls, personal protection equipment, or monitoring on the boundaries*. *Monitoring on the boundaries* generates data about air and dust emissions, and alerts experts to equipment malfunction or poor site management around earthworks. Experts also position *monitoring on the boundaries* as the *interface between the community and the project*. For example, *quite expensive odour control (can have) a flow-on effect for community health. You can know when you should ring an alarm bell, and when you shouldn't.*

Experts are enthusiastic about their capacity to address uncertainty by attention to continuous improvement. *We've seen some big changes over the last decade in terms of how those impacts to off-site are managed, particularly with odour and volatiles in buildings, and now excavations with emission controls. We're getting better ...at implementing and know...what to add...what we need to do.* An inquiring mind is the key here, since *professionals that are worth their salt challenge that uncertainty, ask many more questions... that lead us to change the way we might deal with the problem.* One expert is not so assured, describing environmental management as *riddled with scientific and technical uncertainties*, and another expert draws a wider frame when he says *I'd love to go to a conference...dedicated to people...just doing all the projects that went wrong...We learn a lot more from when something went wrong than when it went it right...I'd like to see more specifics about 'we tried, it didn't work, we moved on and we did something different.*

To conclude, I find that:

Firstly, experts can understand that empirical uncertainty takes different forms, is represented in various situations, and shaped by different factors around the attributes of the physical world and scientific knowledge.

Secondly, experts can reduce empirical uncertainty by applying analytic mental processes that address risk situations.

To this point, we have made findings about how experts understand and manage empirical uncertainty by using the analytic system. As we discuss earlier in this chapter, the analytic system is one of two modes of thinking, the other being the experiential system. It lies predominantly within the unconscious mind, and within it, perception develops. So let's go now to findings about perceived uncertainty.

5.3. Findings about perceived uncertainty and risk amplification.

Generally, the latter part of the 20th century could be seen as one giant experiment, given the technical interventions into life on the planet.
Remediation expert.

During in-depth interview, experts provided their perspectives about how and why non-experts understand empirical uncertainty differently to themselves.

Experts are aware that non-experts can frame risk from different perspectives to their own in that *the perception of risk can be very different from real risk*. They identify peoples' senses - smell, feel, sight and touch, as the primary governors of their perception of a risk. It is, as Wachinger et al. (2013) explain, the "personal experience of a...hazard and trust or lack of trust in authorities (that) have the most substantial impact on risk perception" (p.1049).

Risk perception can be driven by *fear (of) emissions* brought about by *the perception of the lack of control of the combustion process*. *If people perceive something as being a significant risk to them, it's very difficult to argue. People had a view that the steam contained nasties, where in actual fact it was 99.9% steam.*²⁸ Here, we see that perception of a risk begins with the senses, when people see emissions, and proceeds to emotions, which, in this example is the distrust they feel towards those in control of the emissions. In the Peircean schema, this is represented as a process of semiosis whereby the object (the stack) sends a signal (the steam) which gives rise to the

²⁸ The steam being referred to here is steam from the stack of a POPs thermal destruction plant.

interpretant (fear or distrust). We discuss this situation further in Chapter Seven, Section 4.3.

Experts identified other situations where non-experts experience of odour heightened uncertainty and amplified risk perception. There are situations around *putrescible waste and tarry wastes* where people experience...*very pungent odours. First you smell it (and) don't recognise (it)..It's usually not a pleasant odour.* People experience *unexpected...acrid smells...(and) believed that consequently there was something bad in the atmosphere.* Experts understand that an odour does not necessarily indicate a risk, and appreciate that non-experts might not see it this way because their senses tell them otherwise. *Even if the odour is below that action response level, it's ...hard to communicate that when somebody is experiencing that odour, and...at the same time experiencing a health symptom. The local residents...think that they are going to die of some sort of contamination problem because of the smell that is coming from something that got broken during some other remedial work.*

When non-experts smell something odourous, or inhale air-borne dust, they are unable to identify which of these two hazards poses the greater risk and perceive the lesser risk as greater, when in fact it is the lesser of the two. *The public's perception of risk was not through the dust...It was through what they were experiencing as a physical impact. (They were) ...experiencing odour,...therefore their perception was that odour was the highest risk factor, when in fact, the environmental factor that was more relevant.... was dust.* In this particular situation, experts had previously assessed the main health risk as exposure to airborne dust, not to odourous airborne substances (Thiess Services Pty. Ltd & Parsons Brinkerhoff, 2002).

Sight combined with smell can trigger a heightened perception of a risk, for example when *a bunch of equipment turns up on site...(and experts are) digging a bloody great hole, and all sorts of smells come out of the ground. You can see something, and it brings back a memory. People make connections between odour and it's emotional. People associate an odour with something they don't like...If there's a remediation going on, and they're unhappy about it and they get a whiff of it...immediately it can set up an emotional reaction. You have a sensory and...an emotional reaction.* Here we see Gregory et al. (2006)'s experiential mode of thinking in play, where the affect

heuristic allows an individual to draw on the memory and experience of uncertainty, and the risk it could imply.

One expert explains the connection between odour and emotion by referring to *evolutionary and biological* factors. *A natural odour like hydrogen sulphide...is associated with some sort of anaerobic decomposition. You smell it and your brain tells you it's not good. It's an unpleasant odour for good reason, because it's usually associated...with microbial activity that is not healthy for human beings.*²⁹ This expert refers to new knowledge about the senses and emotion: *There's further information now.... The message (that) gets to the brain is situated within the limbic system where the emotions reside. So you smell something, and it can take you back to your childhood, or take you back to a bad situation, or...a good situation. Odours can prompt your memory. ...It's well reported... in psychology (and) physiology. Some functional MRI* ³⁰ *has been done now to suggest that that part of your brain lights up when you smell things.*

Sword-Daniels et al. (2016) find that past experience of pollution can influence peoples' perception of a current pollution risk. Driedger et al. (2002) is specific when she refers to "key moments" that "were seen to engender challenges in terms of the interpretation of uncertainties" (p.795), and Vandermoere (2008) refers to contamination situations "which illustrate that personal exposure has an positive effect on risk perception and is part of the 'dread factor' " (p. 389).³¹ One expert understands this possibility when he states that *people have to live with uncertainty*, and their perception of it *perhaps...has to do with what you have been exposed to over the years.*

So if bad experiences influence peoples' risk perception, what about the influence of lack of knowledge? Does that affect their perception? As far as experts are concerned, it can. Non-experts *don't realise it, or haven't been educated. There's still a very basic*

²⁹ Author's note: In early times of human evolution, those that survived poisons did so because they learned to recognise that a particular foul odour was associated with a dangerous substance or process. Once they associated poisoning with the odour emanating from such a substance, they would avoid it in order to survive. In this way, humans learnt about poisons because some of them died by poisoning. For this reason then, foul odours stimulate an immediate behavioural response.

³⁰ MRI refers to Magnetic Resonance Imaging.

³¹ Here, "positive" is associated with an increase.

lack of appreciation. It doesn't occur to people that there's a design process involved that requires analysis. The public's lack of knowledge about a well-characterised contaminant can lead to an over-estimation of the risks it might pose. *Mercury is not a nice thing. But you can get more mercury out of a can of tuna than out of walking around an (industrial) plant...The context needs to be conveyed.* However, one expert concedes that his professions lacks awareness that differing educational levels can influence non-experts' feelings of uncertainty. As he explains, *remediation professionals probably misjudge how that (uncertainty) might be perceived by a member of the community who doesn't have the same degree of training and experience. They don't know it.* Here, we see that the expert understands that lack of familiarity with a risk can amplify how it is perceived, and thereby encourage distrust. This brings to mind the connection that Luhmann makes between lack of familiarity and distrust, when different groups are uncertain about, and at the same time negotiating, a risk.

At this point, the question arises as to whether lack of knowledge is a sufficient explanation for the mismatch between uncertainty as understood by the expert and by the non-expert. It need not be. For example, experts account for mismatch by reference to political positioning around competing knowledge forms when people *don't want to know it.* (When an expert) *tried to get across to them,...they just held on to this fact. Significant social or political ..aspects...may involve the client or the community and stakeholder, and community relations can bring a job unstuck.* Here, we see alignment with Gregory et al. (2001)'s finding that sometimes, people hold fixed philosophical positions about technological development and oppose it, regardless of the degree of risk and uncertainty it implies.

In the following chapter, there are more findings about the wider frame around uncertainty and distrust, but at this point, let's see what experts have to say about lessening the gap in understanding about empirical and perceived uncertainty. What helps? One expert considers that non-experts' feelings of uncertainty may be reduced if two conditions are satisfied. Firstly, when the scientific risk is within approved limits, and secondly, when social engagement combines participation with knowledge transfer: *You can argue in technical terms, to change their understanding around those potential risks. If you're talking to people who are really uncertain and therefore not trusting the information, then if you invest in education over time I would imagine that*

uncertainty will change. Here, the knowledge transfer is from expert to non-expert, but it can be the other way around. An expert initially dismisses a *resident's concern about the odour* because he considered it to be based on emotions, but later when *he learnt to listen to this concern...*(he) *came to understand that the other person could smell it, whilst he could not detect...the burnt odour.*

To conclude, I find that:

Firstly, experts can understand that perceived uncertainty is shaped by the experiential mode of thinking which preferences the senses, experience and memory.

Secondly, experts can understand that perception of a risk is amplified when people draw upon their experiential mode of thinking.

Thirdly, experts can reduce non experts' perceptions of risk when they exhibit situational awareness, provide credible information over time, and accept the validity of non-expert knowledge forms.

By way of conclusion, Figure 5.1. below provides a visual representation of differing perceptions of an empirical risk. It illustrates how an image of two POPS waste destruction plants with visible emissions might be perceived by different stakeholders.

5.4. Overall findings about uncertainty.

As a contribution to the uncertainty discourse, my findings align with research into social, political and cultural construction of risk, for example Dake (1992) and Boholm (1998). The findings concern existing, absent or conflicting knowledge forms, the individual's way of thinking, their experiences, and memories and situation in life, and their relationship to others. When taken together, they provide evidence of the capacity of experts to understand why a phenomenon that is intimately known to them might not be understood in the same way by non-experts.



Differing Perceptions About POPs Remediation Risks

Figure 5.1. "The Power of Imagery in Mass Media Communications. Slide 14. (Hughes, 2014). Original photo sourced from Image Survey.

To conclude, I find that:

Firstly, experts can recognise that the presence of two, contemporaneous modes of thinking can generate a misalignment of meaning between empirical and perceived uncertainty.

Secondly, experts can reduce any misalignment of meaning between empirical and perceived uncertainty when they allow a place for the experiential mode of thinking.

Let's now go to the next chapter and consider findings about trust.

Chapter Six. Analysis and Findings: Trust and Distrust.

A line in the sand...this is what I'm willing to do and no, I'm not willing to do that.

Remediation expert

You must have trust of the people so you've got to tell it as it is, and if you are not prepared to do that you shouldn't communicate. Remediation expert.

This is the third of five chapters that present the findings of the research inquiry. I begin by referencing some relevant trust literature, and then present two sets of findings. One set is from in-depth interviews with experts. Findings are about how experts conceptualise trust, and their understanding and experience of trust in situations where communication about remediation risks is in play. The second set of findings come from the focus group, where non-experts provide their perspectives about how trust might be built or lost.

6.1. A refresher on relevant literature about trust.

“The pillars of trust must be built on solid ground. The supports of trust are mainly found in opportunities for effective communication, in the possibility of reaching a definite agreement in the kinds of statement in which truth is demanded” (Luhmann, 1979 , pp.55-56)

Two critical distinctions are made about trust which have direct relevance to this inquiry.

Firstly, literature distinguishes between social (or general) trust, and system trust which is understood as confidence by Earle and Siegrist (2006), and explained in terms of the management of “left over uncertainties” by Luhmann. In his schema, when uncertainties cannot be reduced by social trust, they can be addressed by those who can perform “a special task” and who thereby might gain the provisional trust of others. Such people are those who can “ successfully fully master ambiguous circumstances,... in other words, reduce complexity” (p.25). To do this, a person needs to be competent and here we see a role for the expert.

R. E. Kasper (1986) points to the connection between trust and competence when he proposes that trust is in part, around “credentials, command of information, the judged entity’s performance, procedural efficiency and performance.” (p.86)

The other critical distinction made in the literature is between trust and distrust. As Luhmann allows, they are functionally distinct and both are required for system stability, be it technical or political. As he explains, “systems are rational to the extent that they encompass and reduce complexity, and this they can do only if they possess understanding of how to make use of trust and distrust.” (p.89-92) In this schema, trust functions as a social mechanism. “To show trust is to behave as though the future is certain.” (p.10) Since the future is unfamiliar and, where technological systems are complex, “most people have to extend trust from its taken-for-granted familiarity and seek a new mutually stabilising relationship., Systems are able to provide for trust and distrust alongside one another....The trust in systems as a whole can.....depend decisively on trust being curtailed at critical points and distrust being switched on’ (pp. 89-92, underlining added).

Grunig (National Academies of Science, 2015) associates trust with three moral traits around credibility: integrity, dependability and confidence and, as with Luhmann, allows “that trust and distrust are not opposite” (p.10). Grunig extends the distinction between them beyond the credibility issue, and proposes that distrust is not only associated with lack of credibility, but also around willingness to deceive, to take more than is given, or to act in a malevolent way, which he associates with willingness to lie to increase profits” (National Academies of Science, 2015 p.7). Freudenberg (1993) identifies vested interests as a factor that leads to distrust. He proposes that those who control real-world risk management decisions defend their vested interests by portraying the lay public’s perception of a risk as irrational, even when their concerns about it are valid (p.911-913). Gregory et al. (2006) observes that “it seems wrong to dismiss the non-factual perceptions purely because they appear irrational to those with expert knowledge (p.34)

In other literature, trust tends to be a taken-for-granted premise that leaves no room for distrust, for example, Heath et al. (2010), Commonwealth of Australia (2013), South Australian Environment Protection Authority (2015) and International Association for Public Participation (2013). Current social discourse tends to reflect this. Today, we

hear so much about building trust, but not so much about trustworthiness. Gregory et al. (2006)'s observation is resonant here. They write that it is "odd that in academic writings-both philosophical and social scientific-the focus is heavily on trust rather than trustworthiness." (p.31)

Whilst Luhmann and others define trust in terms of its function, others prefer to describe its characteristics. For example, Poortinga and Pidgeon (2003) position trust around competence, trustworthiness, objectivity, fairness, caring, consistency, commitment, predictability and faith, this latter being "the perception of 'good will' of the source" (p. 962). Peters et al. (1997) couples credibility with blind trust, and associates them both with an individual's perception about another person's knowledge and expertise, openness and honesty, concern and care (p.43).

Researchers do consider trustworthiness around action, including Trettin and Musham (2000) who define it as "the state of being believable, trustworthy, reliable." (p.412) They reason that "it is possible to find a person credible without finding that person entirely trustworthy, just as it is possible to trust a person without finding that person credible, to believe he is honest but misinformed" (p.412). Here, it is a person's credibility that is associated with trust, but requires capacity as well as belief, since people can only be credible if they demonstrate that they can be "setting reliable standards, reliability of rules or procedures" (Trettin & Musham, 2000 p.423). As Luhmann puts it, " the problem is not who earns trust, but how he earns it" (p.61). Hudson (2004) refers to action when he proposes that "under conditions of uncertainty and complexity, sustained effective coordinated action is possible only where there is mutual confidence or trust" (p. 75).

Here we see recognition of the need for more nuanced terms than 'trust' and 'distrust'. Non-experts might not trust experts until their individual concerns about risk are addressed. In this sense, trust in experts cannot be absolute, and it is here that the construct of critical trust comes into play. As Pidgeon et al. (2007) explain, critical trust is "a practical form of reliance on a person or an institution, combined with a degree of scepticism" (p.134).

The question then is, who can people trust? Naef and Schupp (2009) draw on the work of Coleman, who operationalises trust through the action of placing trust. What is important here is that the word trust is represented as the verb 'to trust', rather than

as the abstract noun, 'trust'. Recalling the findings of the literature review, we can appreciate that if you want to trust an expert, you need to have confidence that the information they provide to you is credible. Characteristics of an expert's knowledge form that may increase or decrease people's trust in them include the transparency of its provenance, the independence of its creators, the accuracy of its claims, its comprehensibility, its accessibility, perceptions about competence and absence of bias (Board on Population Health and Public Health Practice, 2013; Eiser et al., 2009; Fischhoff, 1998; Freudenberg, 1993; R.E. Kasperson, 1986; Morrissey et al., 1998; Vandermoere, 2008).

Despite findings about the need for credible knowledge, its value can be overlooked. As Earle and Siegrist (2006) observe: "It is the obvious, but often unacknowledged, fact that participants' trust judgments depend critically on the information available to them" (p.384). In sum then, the most useful approach to understanding the nature of trust is one that positions it as an action rather than an abstract concept, and allows that distrust and distrust have separate functions rather than being represented as the opposite of each other.

So what did my research find about experts' capacity around trust situations? Let's go to the analysis and see what has been uncovered.

6.2. Findings about the situational awareness of experts: 'the self' and 'the other'.

Experts were asked questions about trust which explored their approach to social engagement, their understanding of empathy, their experience and communication skills, and professional judgment and attitude to the confidentiality of risk information. Two questions were about the meaning of public and private values, and the data they yielded was analysed in Chapter Four.

Experts frame their understanding of trust around awareness of 'the self' and 'the other'. *They need to have very strong self-awareness so that are able to understand how they are being perceived by the non-expert. Awareness of self is when we don't say we are experts, we say we are specialists. It comes down to the individual...to personality.* Experts express positive human emotions such as humour to *diffuse a*

situation. They can maintain composure: You might have an informed debate. You have to keep calm, move on because there's probably bigger issues. They can be enthusiastic, humble, self-effacing or not arrogant, just clam up or be technically arrogant, too effusive, or patronising.

When experts allow emotions to show, it need not imply that they are *being emotive*. They might be being honest about their feelings, as one expert reveals when he challenges the trustworthiness of a non-expert: *There was a particularly heated exchange...I said...I can understand why you don't trust us, but sometimes we don't trust you either. People...gasped, thought 'wow', that's actually the truth.*

Awareness or lack of awareness of 'the other' is evident around emotions. On the down side, an expert is *intellectually arrogant* or *virtually scoffing at those around them*, or, on the up side exhibits *emotional intelligence* or *natural behaviours*. Some experts are aware that non-experts are position them as 'the other' due to *an ideological position* or *a predetermined or entrenched position* where they *have a distrust of you as a natural starting point...didn't trust big business. You are automatically the enemy the first time you turn up*. Botterill and Mazur (2004) allows this when refers to "formed opinions which are difficult to change." (p.15) We also saw this situation reflected in the previous chapter.

Experts connect non-experts' opposition to a technology with the distrust that they might feel due to their past experience of irresponsible corporate behaviour: *The history of most of the companies that are involved in remediation is one of very severe commercial greed. The non-expert might ask can I trust this person with the information that is being given?* Earle and Siegrist (2006)'s proposal that value similarity underpins social trust is useful here, except that in this situation, we are looking at a reverse situation of value dissimilarity. Experts consider that one persons' judgement about another person's propensity for greed brings distrust into play, and compels them to question that person's trustworthiness.

Distrustful feelings are generated in situations *where the community was being ramroaded...did not trust the company*. Freudenberg (1993)'s understanding of the connection of distrust with recreancy aligns here, as does Evans and Plows (2007)'s connection between distrust and an institution's track record (p.832), and R. E.

Kasperson (1986)s reference to “how a particular risk has been mismanaged or neglected in the past.” (p.277)

Experts positioning of ‘the self’ together with ‘the other’ allows them to understand how trust between people is operationalized. Experts *have to reflect and understand ‘he’ or ‘she’s’ self, understand how they are being perceived by the non-expert. It’s a personality thing. People will perceive you as...trustworthy... (based on) your body language, your mannerisms, your tone of voice.* Experts need to respond to situations by *listening and attention, thoughtfulness, not being dismissive, willing to engage seriously and display an interest in their audience. Social aspects aren’t trivial or unimportant.* Experts need to *understand...the other person’s view and be mindful of public values, concerns (or) views.* One expert will not allow himself to be dismissed as just another ‘company man’ when he refers to *the way you come across to people to demonstrate that you’re a person not a company robot.* Here, he is building credibility, acting, as Peters et al. (1997) propose, to *defy a negative stereotype* (p.54).

To conclude, I find that:

Firstly, experts can exhibit situational awareness during a risk dialogue when they show awareness of ‘the other’ as well as ‘the self’.

Secondly, when experts exhibit situational awareness, they can build and retain the trust of ‘the other’.

Thirdly, experts can show positive and negative emotions during a risk dialogue.

Fourthly, when experts lack situational awareness, they can create distrust between ‘the self’ and ‘the other’.

Let’s look at how experts understand empathy.

6.3. Findings about experts’ capacity for empathy and sympathy.

You need to have the capacity to empathise, it’s absolutely crucial.
Remediation expert

Experts were asked to explain the meaning of empathy, and they did so

by using a culturally familiar analogy about shoes. You *walk a mile in their shoes* or *put yourself in shoes of the other person*. Experts select the verb 'to understand' to explain empathy. It's *understanding how they're effected emotionally*. They allow for 'the other' in that empathy is around *somebody else's perspective, concerns, feelings, needs, fears, a bit more active than understanding. Not a literal embrace, but a willingness to put the arm around someone's shoulder*.

Given this, the question arises as to whether putting your arm around someone's shoulder is empathy or sympathy. One expert distinguishes between the two when explaining that *to actually empathise you have to have been there, and you usually haven't been there...Sympathy is more important...because you can sympathise*.

Experts can show sympathy for a family situation in that *something...doesn't smell good...A risk for their child*.

Regarding 'being there', experts provide a locational context around empathy, referring to *those people living and working at the front...I...am not in that position, (I am) a professional not living in an area*. Experts explain how they exercise empathy by developing a *rapport, trying to understand why they feel that way*. When *they get really mad about something...try to...understand what...they are upset about. You drop all of that tension...You say...that you have thought long and hard about the situation from their perspective...You understand...there's a concern that might be posing some kind of unacceptable risk*.

Experts explain why they exhibit empathy by referring to their own experience around exposure to hazardous chemicals. *My uncle...said they used to blow the asbestos dust out of the brake pad with a reverse vacuum, and it would go everywhere. (He) developed mesothelioma³² due to his work...He committed suicide. I have a cousin. It was his father who developed mesothelioma. He worked with his father since he was a teenager so he doesn't really know what's on his plate in the years to come*. Another expert recalls the impact of POPs exposure on a family member, explaining that *an uncle ...passed away at 62...He was exposed to chemicals over the years*.

³² Mesothelioma is a type of cancer of the lung caused exclusively by exposure to asbestos. In virtually all cases, mesothelioma is a fatal disease.

*Dieldrin*³³...His death was never investigated but I always held that suspicion that he was too young to die.

Experts can be sceptical that the exposure could have caused ill-health. One expert refers to an industrial site *where there was some vapour or odour...I felt ill. Just vaguely nauseous...It didn't turn into anything.* Another expert is aware that in the home, *there is real potential...All the coatings, the fabrics, the materials... ..A lot of that is a bit overblown in many situations.*

To this point, we might allow that experts who have witnessed familial exposure to contaminants and remember it, might be more empathetic than others. The two experts quoted above whose uncles had died are women, as is another who associates a capacity to empathise with being a mother. *I know about the maternal feelings, fear of the unknown, so I try to put myself in people's positions and see what it is I would be feeling in a situation where I knew nothing....and relying on somebody else to communicate those risks to me. It might be a younger couple...They would rather get it cleaned up before they have a baby. That's putting yourself in the shoe of the person.*

Does this imply that women have more capacity for empathy than men because of their greater sensitivity around emotional states? There is psychological and demographic research that could throw light on this possibility, but it lies outside the scope of this research. Suffice to say, it's worth remembering.

Experts identify attributes of scientific language that communicate a lack of empathy: *The terminology that our industry uses is very stark and dehumanising. The term 'receptor', people at some stage realise that you're talking about them...You can't dehumanise to that extent. ...It must have a subjectivity associated with it.* Constraints on empathy are also about its potential to compromise a contractual situation: *I don't know whether empathy is going too far because you might take on everything that they're doing.* Here, we see that an expert's willingness to express empathy may not extend to agreement on every aspect of concern. In other words, this expert is not prepared to express unconditional empathy. He is not however, without feelings for

³³ Dieldrin is a POPs insecticide listed under the Stockholm Convention

the other person's situation and understands the need to think about *what's driving that person to take that position, (to) have a difference of opinion.*

Experts identify attributes of scientific language that give the impression of a lack of empathy: *The terminology that our industry uses is very stark and dehumanising. The term 'receptor', people at some stage realise that you're talking about them... You can't dehumanise to that extent. ...It must have a subjectivity associated with it.* Constraints on empathy are also about its potential to compromise a contractual situation: *I don't know whether empathy is going too far because you might take on everything that they're doing.* Here, we see that an expert's willingness to express empathy may not extend to agreement on every aspect of concern. In other words, this expert is not prepared to express unconditional empathy. He is not however, without feelings for the other person's situation and understands the need to think about *what's driving that person to take that position, (to) have a difference of opinion.*

To conclude, I find that:

Firstly, experts use of language can assist them to accurately describe the meaning of empathy.

Secondly, scientific language can give the impression of lack of empathy.

Thirdly, experts can explain how they exhibit empathy.

Fourthly, experts can connect the capacity to empathise with past personal experience.

Fifthly, that experts can exhibit empathy towards non-experts.

To this point we have seen that experts are aware that trust has experiential dimensions around the connection between 'the self' and 'the other', and understand the meaning of empathy and why this mental state is important in risk communication. Let's go now and look at experts' professional capacities.

6.4. Findings about experts' capacity to communicate that they are competent.

If I'm sitting there wanting somebody to...trust that person, I want that person to come across as knowing their subject. Remediation expert.

Experts' capacities to communicate that they are competent include referring to their expertise and training, their use of language and awareness of the information needs of others, their willingness to acknowledge constraints on their knowledge, and their capacity to communicate ideas around benefit.

Experts provided their perspectives about their capacity to communicate that they are competent in their chosen field. *Knowledge of the topic is critical. It needs to be factually correct. I couldn't get up there and spout off about a topic that I'm not knowledgeable on and get people to trust me.* Experts connect competence with confidence in that they need to provide *some level of confidence that whatever we're going to do can be accomplished*, or to explain *what that technology...can do and what it can't do*. They need to *communicate what's being done is for the benefit of the environment and the community, for the right reasons, safely*.

Exhibiting leadership is a way of communicating of competence. *Experts have a role as leaders...and shouldn't shy away from that. Everybody knows...that (an) expert does have a view, and... should be willing to express that.* They can explain *things that they don't expect you to tell them, where things have gone wrong, not just pandering to what you think the person wants to hear*. Here we see alignment with TCMM which associates confidence in an expert with an expert's capacity to provide performance-relevant information. In this schema, performance-relevant information relies, among other things, on evidence, ability, experience, control and competence.(Earle et al., 2007p.386)

To conclude, I find that:

Firstly, experts can connect confidence with their competence to communicate information sourced from their chosen knowledge form.

Secondly, experts can understand that exhibiting leadership during risk communication supports notions of competence.

There is more about experts' capacity to communicate with non-experts in the next chapter, but for now let's consider the situation around knowledge availability. Whilst experts can draw on their own knowledge forms to communicate scientific facts about risk, they can also hide unpalatable facts. This brings us to the issue of the transparency of expert knowledge and its relationship to distrust.

6.5. Findings about experts' attitude to knowledge transparency.

While we want to get the outcome that the proponent is looking for, I don't think there has ever been a situation where we have sat down and said, let's make something disappear or something appear...I'm confident that most professionals act in that manner. Remediation expert.

Experts were asked if they had had access to confidential information. Of the seventeen experts interviewed, 7 had had access to privileged information, 8 had not, or were not aware that they had, and two did not respond to the question.

Experts offered contrasting views around knowledge transparency. On the one hand, knowledge had to be available and understandable, on the other hand, access to it might be qualified, restricted or delayed.

Experts connect knowledge transparency and access to knowledge with the building of trust. *You must have trust of the people so you've got to tell it as it is, and if you are not prepared to do that you shouldn't communicate. You have to tell people the truth. That's part of the process of building trust. People won't trust you if they feel you're...holding information back. It's a matter of giving straight truthful answers ...and not a spinned approach. You've got to make it transparent, be absolutely up front. ...If I knew it, the community had to know it. Transparency can build cooperation to solve a problem: People can be a lot more tolerant and work with problems if they are identified clearly and honestly.*

The question then arises as to whether transparency of information equates to knowledge transfer, in the sense that it can be understood, as well as received. On the one hand, whilst *soil criteria and health risk studies...have always been available...whether they can understand them or not is another issue. Communities*

are often...non-technical. Companies...are hesitant to release highly technical reports. Consultants' reports (are)...full of jargon (that) the public wouldn't understand. In this sense, transparency need not imply comprehensibility. Moreover, there are practical constraints on full transparency. Whilst *residents need to know the general principles, the specifics that will affect them, human health risk assessments don't cover every single risk, they can't.* An expert can withhold knowledge on the basis of practicality, for example when *we haven't always communicated every single health risk.* The knowledge needs to be *relevant to communities, (and) of comfort.* Here we see a tension between the need to provide comprehensive information, and the potential for information overload or misinterpretation. To resolve this tension, experts can *provide them with support to help understand and scrutinise that information,* but *it isn't done very well, if at all.*

Full transparency has its disadvantages. *It's a two-edged sword. You...try and run through things...people feel like they're being dumped on.* Pidgeon et al. (2007)'s findings align here. They find that when experts try to increase trust by supplying more information, their efforts can be “counter-productive in that it can be construed as failing to take people's concerns seriously.” (p.136)

Experts are frank about limitations imposed on transparency due to the need to protect commercial interests. For example there can be *key legal or commercial reasons why you don't divulge certain things.* Eiser et al. (2009) find the same, in that transparency is determined by external, non-negotiable factors, including the desire of a private interest or government agency to keep information secret. There are also situations where transparency is compromised because knowledge is withheld from experts on the grounds of legal professional privilege. As one expert explains, *there may be more to the story than might be being revealed to me in the first place.*

Experts have different opinions about how much information to provide. On the one hand, *within certain constraints you have to...give honest answers,* on the other, *you can't be a 100% honest with the public.* One expert is *reasonably frank,* and another is described by a colleague as *incredibly open. I felt that I wouldn't have been disclosing some of the material he disclosed.* Here we see that not every expert is confident that a high level of transparency provides any advantage. Some are

confident that they can divulge a lot, or all, information about a risk, whilst others consider that such openness could compromise the interests of a client.

A high level of transparency can impose a personal price. Being *honest...can be personally painful or uncomfortable*. But then again, the price paid may be worth it, since *people recognise a bull shitter when they see one*. What if experts are not *bull shitters* even if they appear that way? This can happen when they cannot control the conditions under which knowledge is released. It might be denied or delayed *for a variety of reasons*. It may not have *been verified or hasn't been confirmed*. It can also be that despite a *broad framework of openness, risks were communicated either very late or not very well*.

Delays in communication about a risk, or poor quality risk information, are common enough. The popular non-fiction and NGO genres we review in Chapter Two provide examples of when private corporations delay communication about an empirical risk, or provide misleading or incorrect information about it. Both activities are driven by the need to protect private commercial interests. Regarding delayed, misleading or incorrect information, Van Asselt and Vos (2008)'s observation around uncertainty intolerance is helpful here. They point to the risk owner's desire to present the best possible version of a risk situation, including "the desire to prove no effect." (p.290) In other words, risk owners can be intolerant of any potential for uncertainty and do not welcome information about it.

Experts differ in their position regarding their accessibility of confidential information. Some are not sure, for example, they *don't think so*, or are *not ..aware*. Those experts who confirm that they have had access to confidential information, do so on a 'need-to-know' basis. They identify situations where transparency of raw data is inappropriate, and transparency of analysed data is not, for example when confidentiality of health monitoring data must be ensured. *We take blood samples from a community, I can be privy to the population data*. An expert can see the data early so...*you do have a better view on it before the community does. It's not that the information is withheld once it's been verified.*³⁴ In the same way, *onsite worker health*

³⁴ Epidemiology experts can review population data about a risk that is not generally available to the public until it has been peer reviewed and/or published in medical/scientific journals.

...wouldn't be made available to the broader community because it's not relevant, it's private.

To conclude, I find that:

Firstly, experts can understand that knowledge transparency is limited by practicality, by laws around privacy, by ethical guidelines on confidentiality, by commercial constraints, or by the complexity of knowledge forms.

Secondly, experts can consider constraints on transparency as a normal part of professional life.

At this point, we can see that there can be a tension between the commercial need for confidentiality, and social responsibilities around transparency. Experts need to find a balance between the two, so let's go now and consider how experts understand the role of professional judgement.

6.6. Findings about experts' understanding of professional judgement.

Experts were asked about the role of professional judgement. For remediation situations, experts require professional judgement to control the empirical risks and deliver beneficial outcomes, for example, in the form of usable land. To achieve both, experts use their professional judgement to make, as Lefsrud and Meyer (2012)'s term it, "informed professional decisions." (p.149)

Experts understanding of professional judgement is associated with the meaning of risk, empirical uncertainty, benefit, and the influence of financial constraints. It is positioned as an application of competence, wisdom or experience, and intersects with laws or policy. Its importance varies. Some experts consider professional judgement to be *best practice, paramount, or a required input to our...projects. It should be about marshalling information, not just a... finger in the wind. It is not erratic. (It) follows a logical path, involves processes...to develop evidence to support...claims. (It) is about delivery and risk mitigation, or knowing the trade-offs between the cost...and the benefit of doing something.* Professional judgement is in play around technical standards such as *standard operating procedures, SWOT analysis, or codified ways*

of making decisions. Experts identify situations where the use of professional is inappropriate. For example, when *there's huge uncertainty, professional judgment probably shouldn't be used. There should be more analysis or more robust risk calculations.* They express reservations about the value placed on professional judgement. *It is a weak element of our industry. There is some degree of uncertainty that can creep into the interpretation, because at the important end, the interpretation is professional judgement.*

To this point, we see that experts can understand what expert judgement is, can explain it, and can recognise that sometimes it is applied and at other times it is not.

Hamilton et al. (2006) suggest this when they find that although experts should use professional judgement, “they do not always do so because they do not know how” (p.1). They explain this in terms of “scientists...working at the limits of their expertise”, (p.699) and here, they are referring to limits around the assessment of a risk. However, as one expert explains, professional judgement is exercised within the wider frame of financial risk. *People do have limited budgets. You can't just wastefully spend a hundred million dollars to bring a 99.99% job, where if you spent a million (you can achieve) 99.9%.* Here, this expert is explaining how empirical and financial risks needs to be balanced using professional judgement.

Experts need to address risks associated with legal and policy issues since they too, effect their capacity to exercise professional judgement. Experts are *working in a fairly regulated regime. There's some boundaries, and professional judgement is made within those boundaries.* Boundaries can be flexible, since *most rules, when you look closely, do allow people to stray outside, based on superior knowledge or practice.* Here experts show awareness of tension between law and practice, or between practicality and codification. They consider that regulatory agencies might lack appreciation of the role of expert judgement in balancing the empirical and financial risks. *The EPA need to understand there are costs and the benefits may not be in line with the costs.... They do understand that. Sometime you say to them...'would you mind approving this a little quicker because it's costing us a hundred thousand a month to have people standing around'. When you tell them, they say 'let's give them a bit of priority'.* In this situation, a regulator accepts the professional judgement of an expert, but in another, when it comes to auditing a remediation site, *it's not what the*

EPA looks for in the audit system.... They are not interested in people exercising independent judgement.

Professional judgement can be associated with the age of the expert. It could be that *the more experience you have the better the understanding you have of what the level of risks are. An expert needs an appropriate level of experience, a proven track record....(to) demonstrate your credibility, or be at the upper end of their expertise. An expert might be one of the wise old owls, but, conversely, personal experience through being older can maybe sometimes cloud your judgement. There are some people who are old, but not very wise, and some who are young who are wise beyond their years.*

To conclude, I find that:

Firstly, experts can acknowledge the role of professional judgement in decision-making around risk.

Secondly, commercial factors can play a role in risk selection.

Thirdly, competence to exercise professional judgement does not necessarily accompany greater age.

Let's go now and explore the extent to which experts can exercise their professional judgement within the constraints of time and money.

6.7. Findings about experts' capacity to exercise independence.

If you're being paid by someone, people believe that you are beholden to someone, since while ever a corporation is paying an expert, someone is going to do the money trail. Remediation expert.

I undertook a simple measure of independence when I asked each expert if they had to seek consent to participate in the interview. Fifteen of the cohort of seventeen did not need the consent of another person, suggesting that they have a good measure of independence commensurate with their age, industry, experience and role in the remediation industry (See 4.3.1 above). Richer findings emerged when participants were asked specific questions regarding financial constraints and actions that could

demonstrate independence or its lack. Overall, experts understand that their independence is a core issue for non-experts, and that it is also important for them since it is associated with their professional reputation. The capacity of experts to exercise independence varies around competing professional and commercial factors.

Experts find it difficult to demonstrate independence to non-experts who might inherently distrust them. It is *the hardest issue to deal with. Independence in their eyes is doing what we say we're going to do. People have a mind-set. If they come in with a prejudice you're not going to change their minds.* This default distrust setting has been noted by researchers including Botterill and Mazur (2004), and is referred to earlier in this, and the preceding chapter.

Experts associate independence with credibility and trustworthiness. They can take *steps...to build up trust...demonstrate their independence,* or understand that *you can't buy trust. You have to demonstrate trustworthiness and that's very different, fundamental. If you lose your professional credibility....you're dead in the water.* Credibility is *about reputation, to be ethical, (to) maintain your professional and personal integrity.* It involves *personal responsibility, making sure that everything is done to the right standard. You don't say one project is fine, and another is not when they are essentially the same type of project. You have to tell the same story. ...use the same yard sticks for assessing it.*

Here experts associate independence and credibility with their adherence to technical and professional standards, and again we see alignment with TCMM, where confidence in experts is reliant on the communication of performance-relevant information, including “evidence..., rules/procedures... and standards” (Earle & Siegrist, 2006 , p.386)

There are limitations to experts' independence since they are legally obliged to act in the best interests of their clients, and this situation can foster distrust. For example, *when you're...working for someone...it seems hollow to say that you work to professional standards as an ethical requirement. If you're being paid by someone, people believe that you are beholden to someone, since while ever a corporation is paying an expert, someone is going to do the money trail and argue that it doesn't constitute independence. It becomes pretty clear very quickly as to whether or not you've obtained some level of trust with that community, or whether they're just never*

going to believe you. One of the questions that you're often asked is who is paying you. There is no way around way that.

Beck (1992) understands this in terms of structural constraints to the independence of scientists who, “despite the external preservation of their objectivity.... have become branch offices of politics, ethics, business and judicial practice” (p.82). In the same way, R. E. Kasperson (1986) refers to “a compromised mandate” that can weaken “the credence of information’ (p.277), and Eiser et al. (2009) suggest that credible information relies on experts’ independence, since if they are, they’re “unlikely to withhold or distort information because some interested party is paying them.” (p.296) Lefsrud and Meyer (2012) define independence from commercial interests as being “objective and not driven by particularistic interests” (p. 1481), and reflecting “unbiasedness” (p.1495).

When experts do exercise independence, it can create difficulties for their clients, since they might also be experts, albeit in another knowledge domain. For example, difficulties can occur when the client is the risk owner as well as an expert, and the expert is the contractor. The contractor has to strike a balance between their own professional judgement about an activity, and the desire of their client to contain costs. It is the activity *ultimately...(that) had to be correct, rather than what necessarily the client wanted to hear*. Then again, experts might not like to jeopardise contractual arrangements with a client because they would be at risk of arguing against their own self-interest.

Experts understand what it takes to convince non-experts that they can be independent. *You really can't convince people about your independence except by being independent. If you say something, you need to be able to do it. Basically it's personal integrity*. Experts need to be *very upfront about who they're working with, or for, who is paying them. You separate out the money side from the chain of responsibility*. One way to do this is through the use of *independent expert witnesses*, or the engagement of *independent experts for the independent monitoring committee, providing funding to a community to allow them to exercise some ..independent scrutiny*. In these schemas, experts’ understanding of independence aligns with Lefsrud and Meyer (2012)’s construct of “moral evaluative legitimation” that experts use “to establish their own and others’ expertise” (p. 1495).

As well as being upfront with the community, experts can be upfront with their clients, *ensuring they've got a brief that maintains their independence. The first step ...would be to agree with the group who were commissioning them that they would put it on the table, irrespective of whether it was favourable or unfavourable. They can demand that they are allowed to be independent. The ability for the professional to be independent within that construct is very important.* One expert is frank about the situation: *the consultant by their own ethics, needs to give frank and fearless advice. You can't muzzle experts.* One expert shows his independence by being *thrown out of the EPA's office (when he) went in to question their wisdom one day.* Here, the expert's role is to ask hard questions, but in another situation, a balance between forthrightness and discretion is what is required. *An expert...should be able to say what they think, and if (a chemical company) employs an expert who gets up at a community meeting, obviously you wouldn't want them to say (the company) is a pack of bastards.* In another situation, an expert might, on the one hand be able to give *direct and honest answers*, and on the other, be constrained by commercial confidentiality. One expert is confident that he can offer information to help a non-expert understand something without compromising his client's interests. He can say *I'm sorry I can't answer that question because it's commercial in-confidence. I'm under a non-disclosure agreement. I can't answer that, but I can answer this.* Here, the expert is aware of the existence of privileged knowledge, understands his contractual responsibility around it, and also his obligation to provide relevant information to non-experts. He is, in Lefsrud and Meyer (2012)'s schema, exhibiting "sufficient professional independence" (p.1495, my emphasis).

There are factors that contribute to a lack of independence, including too much client input into, or influence over, knowledge creation. For example, *a report goes through several iterations with the client...because every company wants to have a legal review to make sure they are not subject to any exposed liability.*

Now whilst tension between professionalism and self-interest may be in play in some situations, in others, the law protects professional independence. When experts are auditors, they are *paid to be independent under the Act. We go to jail if we misrepresent things. The role of auditor...is to represent the interest of the state or the community.* As auditors, experts express a level of confidence that the regulatory system safeguards their independence. *It probably works fairly well. I'm audited by the*

EPA. Independence is really critical to the effectiveness of the audit scheme, it's a fairly rigorous government led probity process...so it gives us a level of independence.

Experts look to the future when suggesting *safeguards* to address systemic constraints to independence. It could be *some huge fund that every environmental assessment could access for independent consulting advice, or distinct pots of money from which experts are paid*. This is not a new idea, as the creation of the US Superfund demonstrates (US EPA, 2017). However, experts can be sceptical about the practicalities of this aspiration because *Australia is not very good at this. I don't think that's ever going to happen.*

To conclude, I find that:

Firstly, experts' independence can never be absolute.

Secondly, experts can negotiate the level of independence via a contract.

Thirdly, trust in experts is, in part conditional on their independence, and distrust in experts is associated with their lack of independence.

Let's now consider internal company processes that can also support independence, and by inference, their integrity.

6.8. Findings about checks and balances that support experts' integrity.

However informed or experienced I am, I can't release a report without a peer review... (Experts have to) satisfy themselves that...there are no sweeteners or sweetheart deals stuck in there somewhere. Remediation expert.

Experts explain checks and balances around an individual expert's capacity to act, their expertise, the existence of prescribed professional processes, clarity around corporate governance and client relations, and team building and staff training,

Checks and balances protect *the integrity of the data*. They involve *peer review and rules about processing risk*, and provide *a clear framework around quality requirements, quality protocols, particularly as espoused by the regulators.*

Regarding the quality of knowledge provided to clients, experts are confident in its integrity. They identify *the most important document* (as the) *final report*. It is *usually read by two reviewers with good experience*. There is a *vetting process* that incorporates an *internal QA /QC process*,³⁵ or allows for a *fairly rigorous review*. There are *independent peer reviews*, or *shadow reviews*. *The principle was we always checked every report. Nothing went out without us having the final check*. Other experts are less confident in the quality of knowledge in professional reports. Reports can contain *a kind of a half-truth or spin doctoring*.

Experts identify elements of prescribed management processes designed to protect the integrity of corporate knowledge. For example, *there is a series of gates*. *When we start (a) tender, there's a series of checks and balances...for people to sign off, or protocols for interactions between people*. There's a *gate review*. *The concept of a project is developed, and then there's a gate, and it's reviewed by an independent bunch of people*. *Then there's another gate before all the funding is approved*.

The *gate review* and other management processes are designed to balance the technical and financial aspects of a company's exposure to commercial risk. For example, one expert explains that *every line in the whole job and every instrument is studied in detail to make sure the uncertainties are managed essentially*. Another understands that he *can't put that into our system...unless I fill in a bunch of documents to say what the job is*. Another asks if *the client of a reasonable standing*, and another if *there is going to be certain risks*. *If you're going to accept risk of latent conditions, you are subject to the value of the contract*. *You will need to get certain approvals, ensuring that we take on an appropriate risk profile (so that) the job doesn't fall apart... (and the) projects stop for 12 months...because they got the deal wrong*.

Experts identify *corporate governance* as *key* to balancing the tension between experts' integrity and commercial considerations around risk. It could be *quite a strict governance approach*, or a *governance check and balance* around insurance *because it's the company's responsibility to do this*.

To this point, we see checks and balances that support experts' integrity are, in theory strong, and in practice can be effective, or much less so. Whatever their capacity,

³⁵ Q.A. refers to Quality Assurance, Q.C. refers to Quality Control.

checks and balances can only reach so far, and experts allow for flexibility around the empirical uncertainty that is inherent in their industry. We discussed this in Chapter Five, and here we see how checks and balances are in play around uncertainty. Both researchers and remediation practitioners allow for flexibility in the form of iterative management practices that address uncertainties as they arise, for example Environmental Resources Management (1994), Pym and Sydney Olympic Park Authority (2001) and Gregory et al. (2006). Experts also allow for flexibility in the system. For example, *there's often a bit of too-ing and fro-ing. The system can be quite unwieldy...a bit frustrating. Environmental engineers...try and rein back the project manager who might be more pragmatic.* Van Asselt and Vos (2008) suggest flexibility when they refer to “a system of checks and balances not... relied on blindly”, and propose that such a system will support trust. (p.25) However, their argument might be more convincing if they allow, as Earle and Siegrist (2006) do, that it is confidence, not trust, that is associated with robust checks and balances. These can be provided by rules, procedures, standards and competency, whereas trust is associated with morality-relevant information around values and intentions.

Experts concede that there can be too much flexibility. For example, *there are dangers with check lists. Some of them are probably just in a hurry and tick it off. You can go into auto pilot and just tick the box, 'yes I've done this' without really looking at what you've done.* If experts *don't read it*, they will miss *this issue*. So why do situations like this exist? Is it because a company is just too small, and too hungry for success to observe processes that should be observed? Not necessarily. An expert *worked in a couple of large corporations.... that didn't have this.*

Workable client relations support experts' integrity. *One of the big checks, when you get the information from the client, always question...make sure that it all made sense.* Here, the expert declines to take client information on face value, and in another situation, an expert is able to accommodate client input through the opportunities *for the consultants whose work I am reviewing to provide input...and question my interpretation of information.* The issue here is whether a client's ability to question an expert's interpretation of risk information could constitute a subtle form of pressure to alter any aspect that could be commercially or politically disadvantageous. It's hardly a new idea. There are plenty of past examples in the literature that show this to be the case, and we reviewed some in Chapter Two, for example Adams (1984) and Bellini

(1986). The current debate about PFAS risks reflects a similar tension, for example, Fellner (2017), Lerner (2018) and (Faruqi, 2020).

To this point, we identify pressure from within the remediation industry that can compromise experts' integrity, as well as in-house processes that can safeguard it. Other safeguards are around accreditation, training and teamwork. Training ensures that *people...have a demonstrated competency. It's always possible that someone could be training the wrong way, so there's checks, including yearly performance reviews with goals and key performance indicators to work towards.* However, one expert is yet to see what value *...these accreditation schemes... will bring to me.*

Teamwork is *very important. That's where the checks and balances come from. It's collaborative...relies on you working with others, and not taking it all on yourself. ...You've...drawn on different experience.* Teams are *multi-disciplinary, involving people with the appropriate level of experience and training, including in health, safety and environment quality, financial, industrial relations.* As well technical expertise, teams require *a balance like in society between extroverts and introverts, and technocrats and others, or the right balance of personality to look at these things so that everyone is on the same page.* Here we see that whilst checks and balances can be built into management systems, they also rely on the individual's mind-set-- the way one expert relates to another within the same knowledge domain.

Ethical norms support experts' integrity, including those reflect in company values. We consider this issue in Chapter Four, and do so again here. Experts refer to *professional ethics, or the need to be ethical...maintain integrity. A contact line can be used if you feel like you have an ethical dilemma or a potential conflict of interest, if you think that there might be corrupt behaviour.* There is a *code of conduct (that) applies to all employees, or a due diligence process around the ownership of knowledge. (Community members) ask who was paying, whether I own the reports; a thorough process. They took their due diligence seriously.* Another expert could take action to support integrity: *If I had a concern, I would monitor very closely...I had the capability of being in a lot of places in a very short time.* In this latter situation, the expert is ultimately responsible for a project, and has sufficient resources to take that responsibility. This is not always the situation, since *for a lot of professionals, those ethical and moral codes are a little bit under written.*

Experts experience challenges to their integrity. Nine of seventeen experts have been challenged due to their connections with private sector interests, or the inadequacy of their expertise. Challenges are initiated by a *community group*, a *barrister*, a *government employee* (who) *had a reputation of being very obstructionist*, or *two grumpy old men...property developers...who had bought a contaminated site*. Challenges take various forms. The *grumpy old men threw a lot of profanity at me and accused me of ripping them off*, or a community group accused an expert of *all sorts of things...Who's paying you? You're not independent...You're just saying what they want you to say*. Another challenger is bold when he asks an expert if he has ever *had any criminal convictions to do with environmental stuff*.

Other challenges are around experts' competence, in that people *think you don't know what you're talking about*, or around their credibility, in that *the results look too good to be true*. One expert addresses challenges that arise by offering alternative sources of information: *It's important to offer immediately...independent opinions, or opinions from other sources*.

Here we see a negative side to challenges to experts' integrity. There can also be a positive side. Challenges can be both *very interesting and very confronting*. In one case, *it was just due diligence around a health challenge. It wasn't done in a distrustful way*. One expert enjoys a challenge. *It was really good...overt political...challenges. Quite robust*. Another rejects a challenger's assertion when he *stood up and said I didn't cause your contamination, I'm only here to try and help you fix it*.

Experts themselves can be *part of the checks and balances*, and work alongside a *good balance of people who act as the conscience of the project... acted with integrity*. Such experts are *suitably qualified and experienced*, or are *verifiers* (who) *act as quality agents*, with capacity around *problem definition and the interpretation*. As one expert puts it: *if you don't understand what the problem is, you have an issue*. In this regard experts need to exhibit *insight or critical thinking around some kind of integration*. They need to *engage in the work in a very in-depth way, live the project, really have your brain engaged...rather than just having a checklist*.

To conclude, I find that:

Firstly, experts can identify internal management processes that support their professional integrity.

Secondly, experts acknowledge that there are limits to the effectiveness of corporate checks and balances.

Thirdly, experts can understand that the flexibility required by remediation projects has the potential to undermine their integrity.

6.9. Building, retaining and losing trust.

In this section, we present findings about experts' and non-experts' understanding about trust. We draw on data from the in-depth interviews with experts, and on data from the focus group with non-experts. We also draw on data from Chapter Four generated by non-experts about the expert as an individual, and on data from Chapter Eight generated by non-experts about the adequacy of social engagement processes.

We find that building, retaining or losing trust requires a shared understanding of social engagement and risk communication. A shared understanding of these phenomena can allow experts to practice trust, and non-experts to have confidence that experts can be trusted. Where understanding is not shared, or insufficiently shared, an expert will find it difficult or impossible to practice trust.

Risk communication and social engagement are intertwined and have distinct functions around trust. For this inquiry risk communication is a process whereby content is provided by experts to non-experts, and social engagement is a process which facilitates the delivery of expert content. The distinction is critical since credible expert content might fail to be communicated if the social engagement process is inadequate to the task. In this situation, a trustworthy expert could be distrusted and an untrustworthy expert could be trusted. Conversely, misleading or poor quality expert content might be communicated if the social engagement process is so designed that non-experts are misled about the credibility of that content.

Let's now consider the meaning of trust during risk communication, as understood by experts and non-experts. The expert's interest is in communicating the extent of the risk, for example, the *impact on the residential community*, and non-experts consider that *local knowledge* is an important aspect of risk. Regarding risk management,

experts can *take measures* about *issues...of concern*, and non-experts want experts to *be proactive*. Experts can place a high value on trust in that they *want to operate in a position of trust*, or can accept that non-experts *ought to be sceptical*. Experts might not be sure about their capacity to retain trust: *Apparently I have. You'd have to ask them*. Non-experts consider that the *remediator has to be honest*, and also allow that if experts get something wrong, *it is much better to say, 'we've really stuffed this up, and we apologize'*. Experts have experienced distrust in themselves when there are *vested interests* or *entrenched refusal* in play, and non-experts will *start to doubt everything they say* if the expert is *not honest, influenced by money or manipulative*.

As to the meaning of trust as it plays out during social engagement, experts allow that a fair process *can give them comfort or confidence*, or conversely acknowledge that a town hall *community meeting ..rarely worked*, and non-experts have experienced social engagement as *adversarial*, or a *strategy to delay, confuse you*. Experts and non-experts value cooperation because it gives priority to *a common goal*. Experts are willing to *share the dilemma, or find some peace in the pathway*, and non-experts allow that *you're all on the same side*. Both groups speak of the *common ground*. The two groups shared understanding about the importance of inclusion during social engagement. For experts, for example, it allows the community to become *became a big asset, or a respectful partner rather than a problem*. Some non-experts had experienced inclusive situations in that *anybody could attend*, whilst for others, it was *just the token, 'reaching out'*.

Upstream engagement is considered useful by both groups. For example, experts see value if they *frame it...sooner rather than later*, and non-experts *had done things like this before*. Both experts and non-experts understand that trust is present during a risk dialogue when experts frame trust around their capacity to act. For example, *you need to act, to prove that we were a trusted pair of hands. Telling people 'don't worry' just isn't going to work*. There is a *rise of lay knowledge*. Non-experts frame trust around being *transparent*, with *no talking down*, and both groups allow that a risk dialogue can be two-way. For experts, it is about *bridging that gap so that the information was available to everybody*, and for non-experts, it is *crossing, bridging, or talk(ing) in layman's' language*.

Tables 6.1. and 6.2 below identify measures of *the practice of trust* that can bring about sufficiently effective risk communication and sufficiently acceptable social engagement.

Measures of the practice of trust. Risk Communication		
Measure	Experts' understanding Data examples	Non-experts' understanding Data examples
Extent of the risk	<i>Impact on the residential community. Residential bores, dust or emissions. They had a really good and important level of knowledge about their local area. The community was significantly outraged.</i>	<i>Local knowledge Dismiss local concerns</i>
Risk management	<i>Extract...the issues...of concern. Strongly address the clients, take measures</i>	<i>Have a solution, safety. They should ...be proactive in the way they deal with these things.</i>
Trust in experts	<i>I want to operate in a position of trust, prove that we were a trusted pair of hands so they could have confidence in what was occurring. Someone who has some credibility. Not to think you know everything. There's always room to learn more. Non-experts ought to be sceptical Very open about what was happening. You'd have to ask them. I wouldn't like to claim it. It's hard to know how people perceive you Clear, methodical, not emotive. They genuinely believed what I was saying. Humour...can diffuse a situation.</i>	<i>The persona, holistic. Trustworthiness, confidence. Remediator has to be honest. Factual, definitive, analytical. Competent, qualifications, experience, specialised knowledge. Very helpful, ethics. It is much better to say, 'we've really stuffed this up, and we apologize, and this is how we're going to fix the problem.' Not guarded, no hidden agenda. Our own expert, an expert on our side. Own chairperson, independent person. 'Cool', wonderfully nerdy, poised.</i>
Distrust in experts	<i>Entrenched refusal We're often the messenger, and people do shoot the messenger. (The experts) weren't leading the consultation...(It) was handled by the client. Professional advisors, marketing consultants, someone hired in, consultants that are (earning) \$120,000 a year. His own self-aggrandisement. The way vested interest operates to constrain open knowledge- making processes is rather well known. A complete loss of faith. They had a significant push back and lots of fights.</i>	<i>If experts are not honest, you start to doubt everything that they tell you. Keep lying about it and dismissing people's concerns. Influenced by money, dishonest, ulterior motives, manipulative. Leave questions unanswered. Guarded, abrasive, hostile, unpleasant, combative. Phlegmatic, lack emotion, impersonal, body language.</i>

Table 6.1. Measures of the practice of trust. Risk Communication

Measures of the practice of trust. Social Engagement		
Measure	Experts' understanding	Non-experts' understanding
Fair process	<i>Make sure there's a process in place that can give them comfort or confidence. Engage to the point where they are satisfied.</i> <i>Trust in the process and the people. Endorsement at the community level.</i> <i>A code of ethics and a framework to engage, meeting protocols, agendas, terms of reference.</i> <i>Motivation or emotion influence how they understand.</i> <i>A (townhall public) community meeting ..rarely worked. Decide and defend. When participants have agendas to push, (it) can be blind siding.</i>	<i>They ran it properly. There was a direction. We could ask questions. It wasn't like a town hall meeting.</i> <i>Government departments ...laugh. 'As if we would do a town hall, those aren't constructive'. They won't go into the lion's den.</i> <i>Community Walk-In sessions haven't got a direction. It's more of a strategy to delay, confuse you.</i> <i>It's (an) adversarial kind of situation. Participants are on the ready to attack.</i>
Cooperation	<i>Enough trust so that you can move on to doing something, overcome those concerns together.</i> <i>Share the dilemma. Find some peace in the pathway. Common ground, common goal.</i> <i>Trying to find a way...to progress the remediation.</i>	<i>Most of us don't want the chemical there. You're all on the same side.</i> <i>Find common ground. Engaging with government in a very positive way. Collaboration. Try to fix that with the help of the community.</i>
Inclusion	<i>The community became a big asset, an opportunity to institute some great thinking. Common goal.</i> <i>Consider your community as a respectful partner rather than a problem. Promote buy-ins and partnerships.</i> <i>Community groups had) some real ideas...(and) cultural...aspirations. There was a lot of good will.</i> <i>People are more willing to live with or tolerate something that they have been party to. You rely on them to give you some answers or insights.</i> <i>Involve and decide ... doesn't always happen.</i>	<i>There was no RSVP. Anybody could attend whenever they wanted to. They would advertise that these meetings were on.</i> <i>Community consultation required an RSVP. Now that to me is.. instant put off to your community.</i> <i>This is just the token, 'reaching out', we are the 'other'.</i>
Upstream engagement	<i>People can live with uncertainty if they talk about it from the beginning. Frame it...sooner rather than later. Scientific uncertainty can only be shifted if companies are willing to have conversations very early.</i> <i>Ongoing engagement process, a rapport with ...people over the years. They had gone from offside, to neutral, to onside.</i>	<i>We had done things like this before. (and) had a bit of information before (we) started.</i> <i>I've come from community consultation that I'd say was really well done.</i>

Risk dialogue	Tell people how it will be in reality. You can't say that can happen and then it doesn't happen. If you say you're going to do something, do it. Telling people 'don't worry' just isn't going to work. Be direct Bridging that gap so that the information was available to everybody. An independent expert to facilitate the conversation. Communication at depth. They're legitimate questions. The rise of lay knowledge about environmental impacts.	Building on that trust is to be transparent. Crossing, bridging, talk in layman's language, speak as a human. (We) could do questions and get answers, no talking down. Articulate, a delight to listen to. humble, listening. Able to get a negative message across without being confronting.

Table 6.2. Measures of the practice of trust. Social Engagement

To conclude, I find that:

Firstly, experts can identify aspects of fair process that support cooperative social engagement.

Secondly, building and retaining trust involves action by the expert. If experts loose to control of a risk message, or do not cooperate with each other, they can lose the trust of others.

Thirdly, building and retaining trust requires recognition of the psycho-social and socio-political factors that are in play during social engagement.

Fourthly, distrust can be the default position of non-experts during social engagement.

Fifthly, 'critical' or 'provisional' trust are more useful constructs than 'trust' in situations where experts need to be trusted.

6.10. Overall Findings: *The practice of trust.*

In this penultimate section of Chapter Six, I consolidate the findings about trust.

In line with the dominant trend in the trust literature, I find that trust is a malleable construct, with meaning associated with critical trust, suspended doubt, competence and confidence. Distrust is a separate construct with different functionality, such that during a risk dialogue, trust is only useful when it is partnered with distrust or scepticism. It is this co-existence of trust and distrust that allows experts' credibility, integrity and independence to be challenged by non-experts, and then addressed by experts.

Experts can effectively address challenges from non-experts when they exhibit situational awareness of 'the self' and 'the other'. Situational awareness allows experts to understand that they come from an epistemic group different to that of non-experts, and as a consequence, competing knowledge forms and values can be in play. When experts lack sufficient situational awareness, they are less likely to effectively address challenges as to their trustworthiness.

Experts can address challenges about their competence when they demonstrate their capacity to manage empirical risk by providing credible evidence about their area of knowledge, qualifications and experience. Regarding challenges to their integrity, experts can account for it by explaining the role of professional judgement. Professional judgement is in play when knowledge combines with experience to allow a technically robust approach to risk assessment and risk management. Experts vary in their knowledge and experience, and show a range of educational levels and qualifications.

Regarding challenges to their independence, experts cannot be fully independent from clients. Independence is always provisional around the transparency of knowledge. Some experts are able to negotiate a level of professional independence, and others cannot, but whatever the situation, explaining how independence is maintained remains *the hardest issue to deal with*.

So how can experts convince non-experts that they can be trusted? For any risk dialogue, the answer lies in the answers to two questions: Who do you trust' and 'who can you trust'.

When non-experts such as local residents do trust experts, they are giving them permission to take a risk and remediate lands, - allowing someone whom they do trust to make decisions on their behalf. In this situation, non-experts are taking the action of placing trust in another when a risk is not within their control. They trust them not to cause harm in the same way a patient trusts a surgeon. In both cases, the bestowal of trust is the anticipation of a benefit in terms of reduced risk or a measurable health outcome. Whether or not experts can be trusted is a separate matter. When non-experts identify who they can trust, they are referring to people whom they believe are competent to do something that they, the non-experts, cannot do, and who believe that these delegated individuals have the required level of integrity and independence to deliver an acceptable risk outcome. In this situation, experts can take action to show they can be trusted to manage or reduce a risk, and deliver social and economic benefits.

Here we see trust operationalised as action that reduces distrust between experts and non-experts. Given this, I find that during a risk dialogue, when trust takes the active form, represented grammatically by the verb 'to trust', it is useful to both the involuntary risk takers, as well to those who need to be trusted. When trust remains in abstract form, represented grammatically in the abstract by the noun 'trust', it has a limited utility for those who require others to be trustworthy.

However, there is more to being trusted than being capable of managing the risk. Experts need to enlist the confidence of non-experts by communicating to them that they are competent. I find that it is only when experts can explain how and why they remediate contaminated land to a sufficient standard that they can attract the confidence of non-experts about their competence. I explore the role of language in the next chapter, but here can make findings about trust, distrust, competence and confidence, and fair process.

Regarding trust and distrust, I find that:

Firstly, a successful risk dialogue requires that trust is operationalised as an act, rather than spoken of in the abstract.

Secondly, a successful risk dialogue requires that both distrust and trust remain in play for its duration.

Thirdly, distrust can be the default position of non-experts during social engagement.

Fourthly, 'critical' or 'provisional' trust are more useful constructs than 'trust' in situations where experts need to be trusted.

Fifthly, experts can understand that trust in them is associated with their professional integrity, transparency, and independence from private commercial interests, and that distrust is associated with their lack.

Regarding competence and confidence, I find that:

Firstly, experts can understand that confidence in them is associated with their proven competence in their chosen domain of expertise.

Secondly, experts can communicate that they are competent.

Regarding fair process, I find that:

Firstly, experts can identify aspects of fair process that support cooperative social engagement.

Secondly, the retention of trust during social engagement requires a fair process.

Thirdly, building and retaining trust involves action by the expert. If experts lose control of a risk message, or do not cooperate with each other, they can lose the trust of others.

Fourthly, building and retaining trust requires recognition of the psycho-social and socio-political factors that are in play during social engagement.

At this point, I propose the idea of trust as a practice. *The practice of trust* requires experts to exhibit sufficient competence to remediate contaminated lands safely and legally, and be able to communicate that they can be trusted to do so. This brings to mind the construct of *the persona of the expert* which is identified as an emerging construct in Chapter Four. In this, the sixth chapter, its meaning can be consolidated.

6.11. Overall Findings: *The persona of the expert.*

The Oxford Dictionary of English defines *persona* as “the aspect of someone's character that is presented to or perceived by others.” (anon, 2014)

For this inquiry, *the persona of the expert* refers to those aspects of an expert's character that is presented to others. I define it as a four-faceted construct that supports the contemporaneous application of analytical and experiential modes of thinking as a way to communicate during a risk dialogue. *The persona of the expert* reflects the potential of experts to communicate effectively as professionals, private individuals, emotional beings and communicators.

As professionals, experts can draw on the analytical mode to communicate that they have the competence to undertake their designated role. As private individuals, they can draw on the experiential mode to express any morality-based values that could apply to a risk dialogue. As emotional beings, experts can express their emotions, and can understand why non-experts might express negative emotions around risk. As communicators, experts can draw on both modes of thinking, using language and scientific knowledge to explain the meaning of empirical risk and risk selection.

Here we see the potential for improvement in experts' risk communication. To sufficiently explain empirical risk and risk selection, an expert's *persona* needs to be sufficiently balanced. *The persona of the expert* must allow for a sufficient appreciation of ethics and respect for others, for recognition of the socio-political context of pollution, for professional competence, for capacity around independence and personal integrity, for capacity to explain the meaning of risk phenomena and understand perceived risk. These qualities support any claim to trustworthiness that experts might make. By way of contrast, I find that an expert's *persona* can lack sufficient balance between analytical and experiential modes of thinking, and because of this, an expert may resist ethical awareness, exhibit poor people skills, and fail to acknowledge, or to recognise the wider context of risk.

Let's now apply these findings to the first of the two research questions. It asks: Is there evidence of expert content and processes that can bridge gaps in knowledge and understanding between experts and non-experts who participate in social engagement processes? At this point, I can offer a provisional 'yes'. I find that experts

can bridge communication gaps if they possess a sufficiently balanced *persona*. In other words, *the persona of the expert* can function to reduce the misalignment of meaning between experts' and non-experts' understanding of risk. The emphasis here is on 'can', since there is variation in the extent to which experts are able to balance their *persona*. Some can, some cannot, some can sometimes, and some can much of the time. It depends on the individual.

In the final two findings chapters, I provide further findings that support the construct of *the persona of the expert*. In this next chapter, additional findings about the expert as a communicator are presented.

Chapter 7. Analysis and findings: Expert's capacity for risk communication.

Some people can communicate very well and some people cannot.
Remediation expert.

This is the fourth of five chapters that present the findings of the research inquiry. It identifies key features of literature about the use of textual (written) and non-textual language (visual) and analyses the capacity of the expert to use them to communicate with non-experts. I make findings about how experts select and explain scientific content about risk and benefit, and about how non-experts respond to experts' language. Findings emerged from a questionnaire, in-depth interviews, an image and media survey, and a focus group.

Before we go to the findings, let's recall some of the more pertinent literature about the use of textual language forms in risk communication.

7.1. Literature of risk communication: Textual Language.

Risk communication literature considers textual language associated with the construction, selection and design of scientific knowledge forms, contestation between competing knowledge forms, and knowledge credibility.

Researchers propose that when experts communicate scientific knowledge to non-experts, their language needs to be accurate and understandable, for example Heath et al. (2009) and National Environment Protection Council (2013). Pollard and Heath (2009) connect loss of trust to "getting communication wrong and speaking technically".³⁶ Regarding "speaking technically", institutions as well as individuals can also be responsible for poor communication of technical terms. Gregory et al. (2006) find that there are 14 institutional versions of the meaning of the term 'risk' and 10 of the term 'hazard' (Renn, 2006 Annexe B, p.139ff.). Scheer et al. (2014) provide further evidence of multiple meanings when they identify eight institutional definitions of risk

³⁶ From the final slide of a Conference PowerPoint presentation entitled Twelve ways to Lose Trust"

and hazard and argue that this results “in misunderstandings and communication gaps’ (p.1270). Researchers, for example Van Asselt and Vos (2008) confuse the meaning of hazard and risk, referring to “uncertain risks” which are “new, imaginable hazards (p. 281), and Pollard et al. (2004) fail their own test of clarity about the meaning of these terms. They point to the need to avoid the use of multiple terminologies (p.26), but what follows is hardly clear. They ask “What hazards are present on site? Who or what is at risk from these consequences? How might...the consequences be realised?” (See p.24, Table 2).

With lack of consensus about how to define hazard or risk, the question arises as to who can claim to be the arbiter of their meaning. Bergmans (2008) nominates multiple “actor groups who use a different kind of rationality, a different way of dealing with knowledge and interpreting (factual) information...(T)hey.. have developed different ways of framing the problem and the notion of risk in general.” (p.1800) Here we see a constructionist framing of empirical risk in play. It allows for multiple meanings to apply to the same phenomena, an approach which, as Eiser et al. (2009) appreciate, might confuse communication between groups during a risk dialogue. Scheer et al. (2014) provide a four-fold problem matrix to explain why this is so. One is the *semantic* problem around institutional understanding, and relates to content issues like clarity and accuracy. Another is the *conceptual* problem around competing risk concepts, and relates to content issues around risk construction and assumptions. Scheer et al. (2014)’s identification of semantic and conceptual problems goes some way to explaining why expert content about risk might not be as ‘expert’ as it seems, due to the overlap with institutional and private interests, power relations and associated competing risk outcomes. The conceptual problem is particularly useful because it allows for risk construction to consider not only the meaning of risk, but as well the nature of any benefits that taking a risk might bring forward.

Literature explores benefit as well as risk. For example, the benefits of remediation are associated with reduction in contamination, which together can translate to wider benefits around increased property values, urban renewal and the consequent increase in the tax base, for example, Haninger et al. (2014) and Heberle and Wernstedt (2006). Gregory et al. (2006) look at benefits in terms of possible trade-offs (p.395), and invokes a justice frame around risk and benefit, proposing that risky activities need to deliver a “net benefit to human society and (prevent) harm to humans

and what they value”(p.80). Fischhoff (1998) is more cautious about the benefits of trade-offs since those who bear the most risk are “the most vulnerable individuals or...workers in particular occupations”, as distinct from “the primary beneficiaries of an activity” (p.68). Gregory et al. (2006) propose that fairness about the distribution of risk should be considered, distinguishing between “those who reap the benefits and those who bear the costs” (p.19). Botterill and Mazur (2004) find that those who may have to take the risk will be more receptive to do so if the risk activity is associated with demonstrable benefits.

Communicating benefit as well as risk supports actions that can reduce risk. The National Academies of Science Engineering and Medicine (2017) point to research that shows that “(m)essages framed in terms of environmental and economic gains rather than losses...have led to greater support for mitigation-related actions” (p.37). Here we see a potential for risk-benefit framing as a way to support social engagement. Cross (1998) finds the way a risk issue is framed by experts influences the extent to which people accept it. If a risky product or process is framed as a gain, it is more acceptable than if it is framed as a loss. Onwuegbuzie et al. (2009) allow this, proposing that an inclusive risk dialogue requires framing of situations that avoid acceptance of premature assumptions and instead, “open up spaces” that allow for consideration of benefits” (p.370). Ropeik (2011) proposes that that how people feel about a benefit, the less likely they are to be worried about the risk (p.4), and similarly, Siegrist et al. (2005) find that “when people see benefits from an activity, they may be more receptive to the risks.” (p. 15)

How then could people “see benefits from an activity”? Barrett and Cooperrider (1990)’s idea of the generative metaphor is useful here. It is a way to help people think through what change could mean in terms of any risk it could bring. The generative metaphor allows people “to reframe the purpose” of any change, and “collectively imagine a new and better future” (p. 201). Mordini (2007) also defers to the mental processing of risk messages when he proposes that risk communication about beneficial technologies be framed around wonder and curiosity rather than fear (p.546).

To this point, we see that textual forms of risk communication can lack of consistency in terminology, can deliver confused or conflicted messaging, or deliver messages

about benefits as well as risk, and point to the value of appeals to people's imagination and an orientation to the future.

Let's go now to findings about experts' use of textual language.

7.2. Findings about risk communication: Experts' use of textual language.

In this section, I provide findings about the textual language that experts select to explain scientific content about empirical risks. Textual language refers to written and spoken language forms.

7.2.1. Findings from the in-depth interviews using thick description analysis.

Risk and danger are very slippery in everyday language. Remediation expert.

During the in-depth interviews, experts referred to three terms commonly used in the remediation industry: 'risk', 'hazard' and 'uncertainty'. In this section, I provide findings about how experts' use of certain attributes of language allows them to explain their meaning. In the following examples, verbs, including auxiliary verbs are underlined to draw attention to them.

Experts use verbs to explain how uncertainty is positioned within a remediation situation. Uncertainty is inferred in situations where *they cannot know*, or because they *haven't really come to grips with what might happen*. *We don't know when we started that it might come up and where it might come up*. When uncertainty applies to a health risk, *people need to know the context, and when it does not*, it means that *people really don't understand*.

Verbs allow for the expression of options, for example about financial situations that allow a decrease in the level of uncertainty. For example, experts can *factor (in) uncertainty and interpret, make decisions allowing for uncertainty, have the contractor involved a lot earlier, or price more accurately*. Regarding uncertainty around regulatory issues, experts *make sure that the process complies, the community is protected*, or that wastes are *safely immobilised*.

So why highlight verbs? After all, nouns are important too, since in this inquiry, they name the entity that creates the risk. What is it about verbs that make them useful in risk communication? My findings suggest it is their power to convey the possibility, probability or reality of human action in the past, the present, and the future. For example, something has happened, can happen, may happen, will happen, might happen, could happen or should happen. I'll discuss these grammatical elements of experts' language in Section 7.2.2. below.

Experts use analogy to convey the meaning of the terms 'risk' and hazard. As explained in 7.1. above, they mean different things and an expert explains the difference using analogy. *Think of the road that the car is on as being the hazard, and then the question is, is there a risk? There's only a risk if you get in the path of the car...A way of stopping the exposure pathways is to put a fence up.*

Experts understand that analogy involves reference to a *commonplace example ...that is analogous to the situation. Rather than relying on technical terms...make that analogy with a day-to-day scenario, something that people can visualise.* A pinhead can be visualised since it is a familiar artefact, and experts use it as *an analogy to relate that to ambient chemical levels...Our limit was one nano-gram of dioxin...(which is) equivalent to a pinhead in certain volume.* Swimming pools are used as analogy to explain volumes: *They will often use swimming pools as an analogy. We need to discharge so many litres...(which is) equivalent to so many swimming pools.* These are what Bostrom (2008) refers to as simple analogies. Together with metaphors and comparisons, analogies "can simplify communication, and improve learning and inference." (p.115)

Narrative techniques are used by experts, and research suggests that they enhance the meaning of a phenomenon or a situation. For example, Butt et al. (1995) propose that "the purpose of a narrative text is to tell a story as a means of making sense of the events and happenings in the world" (p.142), and Norris et al. (2005), Hamilton et al. (2006) and Fontaine (2008) position narrative as a meaningful or user-friendly way to clarify the meaning of scientific phenomenon or situations.

Experts use a narrative technique in this way when they explain risk situations. For example, they explain that *rather than just putting out the facts, you tell a story ...about the site, as a way of communication. Site history is really a great way of getting people interested. Traditional cultures use story telling as a way of educating for a reason. It's*

important for listeners to be able to find their way in. Technical information...can be very dry...beyond people's experience. Communication has to be about story telling. Stories can be represented in comics or oral history, interviews or theatre or poetry. In these examples, we see alignment with Butt et al. (1995)'s understanding that narrative" can be both entertaining and informing" (p.142), and with Mordini (2007) 's idea that narrative is "a crucial instrument for trying to influence people's vision of future technology. (p. 546)

Narrative techniques can reflect memory, experience and values, and on these grounds can be positioned within a mental model of risk communication. (Jones et al., 2011). A memory of pollution for example, allows an expert to relate a *fantastic story* about declining *lead levels in Sydney*, or not so fantastic a story about chemical manufacturing at Rhodes ³⁷ when it was *the only place in Australia where the nappies smelt worse after...hanging out on the line*. The message conveyed in Figure 7.1. below explains why.

Petts (2008) alludes to risks like this when describing the "black smuts on washing and windows" which were being emitted from municipal incinerators (p. 829-830). She points to the value of a community narrative because it provides a familiar context to residents' perception of a risk. Less local but also familiar is the narrative about *the Russian or Ukrainian president who had dioxin splashed on his face many years ago*. Here, the narrative invokes a shocking event that suggests, but does not name either the hazard (dioxin), or the risk (exposure to dioxin). In other situations, a narrative might bring forward the potential for risk, and also for benefit. For example, *gasworks-produced waste...(were used) to fill land, and people would see that as a benefit at that time, or they would use it spraying the tar on road or things like that*.

³⁷ A suburb in Sydney where once many chemical manufacturing took place, including production of POPs pesticides and industrial solvents, including by the companies Union Carbide [USA-owner] and I.C.I [at that time, UK-owned]. Remediation allowed new development there.

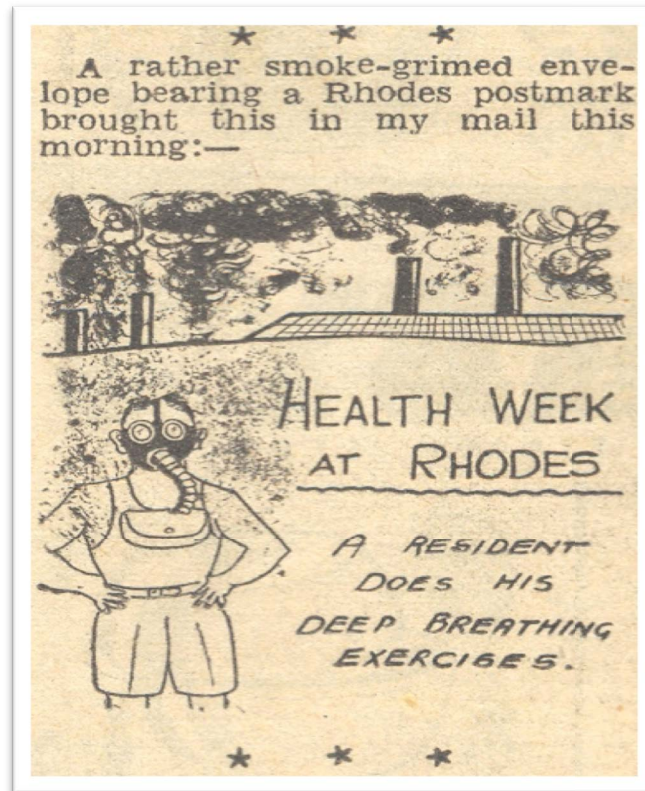


Figure 7.1. A cartoon depicting air quality on the Rhodes Peninsula. Sydney Sun, 31 October, 1946. Public Domain. (anon., 1946)

Experts can be choosy as to when they use narrative. For example, one expert considers that it depends on the audience, since site history *goes over better with older people*. *Young people tend to get a bit annoyed by what they call 'war stories'...* *The young ones want to know it (remediation options) now*. One expert does not use narrative, but understands why they might have been useful: *Rarely I would say, probably not. There might have been opportunities for using the story telling mode a whole lot more than we ever did.*

In sum, experts are conscious of narrative as a communication technique, and might or might not use it. They can recall narratives about an event or situation, including those associated with the history of a contaminated site.

Experts can describe technical terms commonly used in their industry, can explain their meaning and why meanings can differ. For example, they refer to empirical risk as *a number, percentage, the combination of the hazard and the exposure to it*. Risk is about *probability, the likelihood that you would be exposed to a hazard at a level which would cause a problem*. *You can have a hazard there, but it might have no*

consequence... *Either the concentration is not sufficient...or there's a barrier that precludes you from being exposed, so a risk doesn't exist.* Experts refer to the challenges around estimating risk. *It's never that straightforward. There is always the possibility that something can go wrong. A risk could exist...at some stage in the future.*

Experts distinguish between empirical and perceived risk. *There are those non-scientific aspects that can drive the appreciation of risk and understanding (of) risk acceptability.* On the Rhodes Peninsula ...*a lot of the risk was from the site works ... but everyone was focused on the stack of the plant because smoke stacks have an image.... The press, with the 'smoke on the water' ...They were told many times it was a steam plume. The 'smoke on the water' was the mist on Homebush Bay in the morning, but they couldn't help themselves.* Here the expert infers that the mass media misrepresent a risk because *smoke stacks have an image* that makes for good press coverage. The question then is, what sort of image? In modern vernacular, to *have an image* can mean to have an image problem, or a bad reputation, as some contaminated sites might have. In the photograph below, you can see the *smoke stacks* on the Rhodes Peninsula that the expert refers to above. (see Figure 7.2 below). To some residents, the stacks could represent an unacceptable risk because, not only can 'smoke' be seen, and exposure thereby is involuntary, but also, the smoke can be seen arising from two stacks, one for each of two dioxin-contaminated sites that are undergoing remediation. One site is notorious because it was formerly owned by the chemical manufacturer Union Carbide, the company responsible for the industrial catastrophe at Bhopal, and for the production of the ingredients of *Agent Orange*.

One expert explains risk as *hazard plus outrage...it's perceived risk, not the scientific risk. Outrage is the perception.* Here, there is alignment with Sandman (2012)'s popular formula of 'risk = hazard + outrage'. Another expert explains that *in his risk communication...(he) encourages companies to consider what level of outrage might be attached to that hazard if you don't share the conversation around the risk...* (It is) *imposed risk, as opposed to voluntary.*

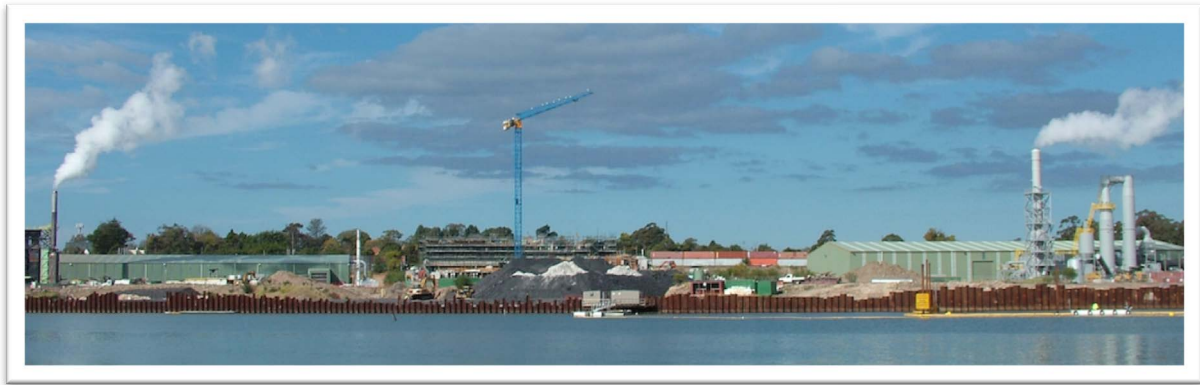


Figure 7.2. Two POPs waste destruction plants operating simultaneously on two remediation sites on the Rhodes Peninsula, N.S.W., 2008. Source. Author's image library. Ecology Data Bank. (Australian Securities and Investments Commission, 2018)

Experts misunderstand the meaning of the term 'hazard'. It is *the outcome, the consequence of a specific event occurring, something that could happen that's bad, or can be equated simply to danger*. Other explanations align sufficiently well with the definition provided by the Commonwealth of Australia (2013) where hazard is defined as "the intrinsic capacity of a chemical, biological, physical or social agent to produce a particular type of adverse health or ecological effect" (p.24). Similarly, experts explain that a hazard is *associated with the property of the waste, the actual physical item that creates the potentiality*. A hazard can provide a risk of harm if there is an exposure to it, or has the potential to cause a negative impact on people. It can kill you, it can burn you. If you don't understand the hazard, you don't know the risk. Experts use examples to explain hazard. There is a chemical present on a site (that is) *above certain criteria*. It can be *dioxin-laden air, waste, contaminants in the groundwater, or is flammable...toxic...poisonous*.

Some experts acknowledge difficulty when explaining the difference between hazard and risk. *It is hard. Even professional people find it hard to wrap their head around hazard and risk. There are even people working in remediation...industries...who don't understand the differences*. One explanation for this apparent confusion could be because *the definition of hazard under the Basel Convention is extremely*

*sophisticated. There are so many different definitions that are applied.*³⁸ Another reason could be the popularity of Sandman (2012)'s formula among risk communication practitioners and its representation in formal guidance (National Environment Protection Council, 2013).

Although widely accepted as a useful way to frame risk, Sandman's formula 'risk equals hazard plus outrage' has limitations around key empirical measures and constructs. For example, Sandman equates risk with risk assessment, and defines it as "magnitude (how bad is it when it happens) X probability (how likely is it to happen)" (p. 6). The question is, what is the 'it' to which Sandman is referring? He calls it "hazard" (p.7) and refers to, for example, "the relative hazard of two risks" (p. 117), but he is actually referring to possible outcome, meaning the result of the risk once it is realised. Here we see that Sandman, a social scientist with good intent and a worldwide reputation, fails to correctly distinguish between risk and hazard, as do some experts. Other experts understand the distinction, and use familiar examples to explain it.

Let's go now to consider how experts rate the capacity of non-experts to distinguish between the meaning of hazard and risk. Twelve experts considered that they did not, and remainder that they did, or were non-committal. On the one hand, experts express confidence in the lay public: *I think the average person could give you a reasonable definition, ...particularly in local communities where risk assessments have been used.* On the other hand, *people don't understand...the baseline figures. They're not simple concepts...How you measure...is technically challenging... That's where we fail to communicate...very effectively.* Regarding failure to communicate...effectively, Scheer et al. (2014)'s concept of linguistic uncertainty resonates here. It is when "people respectively assign different meanings to words...(and) get probabilities wrong ...Risk always needs to be specified by context information on likelihood and extent of damage." (p.1273)

Here the deficit model of risk communication is apparent, since experts attribute communication gaps to lack of technical understanding. However, experts also

³⁸ The expert is referring to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. The Conventions was signed in 1989 and its Secretariat is based in Chatelaine, Switzerland.

recognise that psycho-social factors are in play, again bringing to mind the mental model of risk communication, with its emphasis on two modes of thinking. For example, experts identify *a disconnect between the emotions stimulated by awareness of the risk, and the actual risk. People...can choose not to understand.. motives or emotions (are)coming into situations, or may feel that they are immortal or immune, somehow they can dodge the hazards in some way or another.*

Another factor in play around non-experts' lack of understanding of risk and hazard is the lack of clarity of meaning when a word takes on common usage. *There's confusion about concepts like hazard versus risk...They are used interchangeably in the media or in conversation. Risk and danger are very slippery in everyday language.*

McDonell (1991) finds this when he explains how the association of the phrase 'intractable waste' with the word 'incineration' confounds successful communication about POPs waste destruction because lay people connect them both with public health risks. SARF also allows for linguistic uncertainty. As Kasperson et al. (1998) explain, words such as "'big business' or 'high technology' evoke...specific images...cultural symbols with strong value implications". (p.180)

In the current era, the word 'incineration' remains strongly associated in the public mind with risk to health, sometimes to the detriment of the reputation of other thermal processes that do not pose the same risk (Mazengarb, 2019).

During interview, experts were asked to explain the meaning of the phrase 'taking a risk'. They understand that it can be applied to remediation situations where there is *some combination of danger and opportunity*, or that residents will want to know *what are the benefits and what are the threats*. Experts recognise that 'taking a risk' can involve voluntary or involuntary situations. On the one hand, it is about people deciding for themselves. *Taking a risk is a voluntary thing – it's when you do it. People have a different level of risk tolerance. They can take the risk knowing that the risks are controlled and kept down to an acceptable level.* On the other hand, 'taking a risk' is about *imposed risk*, as when *the community felt they sort of had a gun to their head, the...(thermal destruction) plant was being imposed. They may say, 'I'm not comfortable with that level of risk, there's nothing in it for me', or have a sense of outrage if they were involuntarily exposed to risk. Imposing a decision on a community that they see as risky is going to be setting up red flags for the fight.*

For these type of situations, experts acknowledge that when involuntary risk is in play, it can create conflict between remediators and people who live near the remediation site. They also understand that when non-experts are included in discussion about risk levels, they are in a position to negotiate around the possible benefits they might receive, as well as the risks they are being obliged to take. *People can live with risk and uncertainty if they get to be part of the conversation...get to choose what level of risk (and) uncertainty they are prepared to live with.*

Experts understand that non-experts can connect risk with benefit since they *only take risks if they think there's an upside*. They accept *the potential for an adverse effect in order to obtain...value*. *You don't embark upon those things unless you see an opportunity in it. Ultimately has to be good for the community, something that advanced them...(It is the) benefit at the end of the road*. Here we see that experts understand the action of 'taking a risk' around necessity, opportunity, or benefit.

Changes in the meaning of risk brings forward Botterill and Mazur (2004)'s discussion around the older idea of risk around a wager, and the potential for benefit it holds. Experts appreciate this when they describe how a developer once alluded to the idea of 'taking a risk' by saying to him that *we don't run a casino, it's not based on a flip of a coin*. Another expert also uses the wager analogy when he states that *gamblers would never enter into the dangerous situations ...if there wasn't an opportunity to win*.

Regarding opportunities, experts position them around the possibility of *trade-offs between the costs, the technical solution, the benefit and... inconveniences...to the community*. *You've got to make trades... it's impossible to have everything*. One expert provides an example of a trade-off that he had to manage during remediation project. He stresses that *understanding the trade-offs is important*. *Do you spend a million dollars to capture a kilogram of some contaminant, and maybe the answer is 'yes'. But ...if you've got 25 earthmoving equipment bits running around the spot chasing a kilogram of contaminant, you're probably going to kill somebody with your earth moving equipment, more so than the danger of the contaminant*. In this situation, it is a trade-off between worker safety and the level of remediation that is to be undertaken. It is site workers who benefit in terms of site safety and, hypothetically, the environment that could suffer because some contamination is left on the site. In another situation, a trade-off is between the scope of the remediation project and what

residents wanted protected. As the expert explains: *That's happening at.. (a bay) now they're going to change the scope of the remediation works because the residents didn't want the mangroves removed, and so they've done additional work--and said, "well some of the mangroves can stay and this is good for the residents". They're going to clean up the beach and ...the rest of the bay.*

Trade-offs can be unequally distributed among different groups of people as well as between people and the environment. As we have seen in Chapter Four, experts understand the inherent tension between the private and public interests, so whilst the benefits of remediation include economic uplift, they may not be evenly spread. As one expert observes, *in reality ...some ..people living around those sites ...will get a benefit out of the remediation...If you don't own your house...(where there is an) industrial sort of areas with people renting,...people ...would get no benefit at all, just the hazard.* Research aligns here, proposing that the more disadvantaged people are, the more likely they are to experience risk and receive little or no benefit. (Heberle & Wernstedt, 2006)

At this point, I find that:

Firstly, experts can understand the construct of involuntary risk and recognise situations where risk is unevenly distributed on socio-economic lines.

Secondly, experts can understand that situations where involuntary risk is in play require negotiation to ensure trade-offs.

Thirdly, experts can draw on deficit and mental models of risk communication, and use a narrative technique, analogy, example or verbs to explain the meaning of scientific terms.

Fourthly, verbs have the power to convey the possibility, probability or actuality of human action.

Fifthly, when a scientific term enters common usage, its meaning can become less clear.

Sixthly, the formula 'risk equals hazard plus outrage' has limitations associated with empirical measures and constructs.

Further findings were around experts' communication skills when experts explained their approach to communication during social engagement. The 'approach' refers to *how you're going to communicate things, the adequacy of the communication*. Experts identify the need to gauge the scientific literacy and information needs of the audience. They have to *talk to them in their language, tailor it to the audience, evaluate their audience around its scientific maturity, or make sense to people depending on their needs...level of interest...of education*. They need to *get a sense of where the limits are or quickly move to the level of understanding that they may already have*. Experts need to *understand...when it's not working*. (They might be) *addressing that group in English, but English is not the first language. Some people can process information much faster than others*.

Here we see that experts can distinguish between different stakeholders, and they identify a range of them and their various motivations. Stakeholders can be *the neighbours, indigenous groups, the community, the EPA, vested interests or green groups, the non-local interest groups, Greenpeace and NGOs*. There is a *huge range of motivations...legitimate concerns about these hazardous chemicals. The community is vitally interested in what's happening and rightly so*. People can be *quite open-minded, or just say, 'it's gotta be done, don't worry about it'*. Anyone who is *directly impacted, or perceives themselves to be, has certain rights in a negotiation situation. Dispute resolution...can be driven by different elements, whether rights based, power based or interest based. If you don't engage, and you frustrate these people, they will use...their power-based or their interest-based connections...They will mobilise their networks... That's the N.I.M.B.Y.³⁹, interest based*. A rights based (approach) is from people who are...*directly impacted... If you get your engagement right with these people...you're probably going to have a very successful project*.

There can be a range of influences in play at remediation sites. There is *that interplay between the industrial activity and the community. There can be political and other influences either at the site level, at the interaction between workers and management...industrial relations, CMFU issues*.⁴⁰ There are *vested interests or situations where a company had the deep pockets*. For example, in one case *the*

³⁹ NIMBY. The acronym for Not In My Backyard.

⁴⁰ Construction, Mining and Forestry Union.

owner of the company was a person who was used to getting his own way. People with vested interest include *developers*, and one expert recalls a situation where they would not participate in social engagement because they *believe...that communication is all that fluffy stuff...just an extra added expense*. (They) *don't...understand the value it can bring their project if they do it well*. Regarding *doing it well*, experts are aware that some clients are not committed to delivering a good quality project because they adhere to "the '*cat nap principle*'...*cheapest alternative to narrowly escaping prosecution*". In one situation, the remediators had signed a contract that involved using a technology that residents did not want, but *the American contractors...didn't give a damn what the community felt. They had a contract...and they were going to get on and do it, irrespective of what the community felt. ...The community made it quite clear that they were very unhappy...(that the site owners) were going to use direct incineration...(that they) weren't going to use an indirect thermal absorber*.⁴¹ Residents *wanted (the company) to accept responsibility, which they weren't going to do*. In a comparable situation, *risk communication* about technology selection is amplified and becomes *outrage management...about the methodology on offer*.

People can exercise their right to negotiation around issues that are not directly associated with a remediation situation. They can have *strong political or philosophical objections... using the contamination as a way of trying to argue against any development*. By way of contrast, if *they've lived next door to a factory all of their life*, they might think that *a development was a much better solution (and) would do anything to get rid of it*.

Experts understand that the style of communication affects its quality. For example, experts need to be *human centric*, use *tone of voice*, *facial expression*. *It's not the same story for everyone. It needs a good person to present*. Here, we see that experts understand that not all experts have a personality suited to effective risk communication. *It comes down to the individual...to personality*. For example, *people can be...too effusive with information, other people...just clam up or be technically arrogant or patronising. It's a difficult balance. One of the key ones is (to) try not to be*

⁴¹ Indirect thermal desorption is a method of waste destruction that prevents direct contact between the contaminated waste and heat, and theoretically prevents the formation of pics, (products of incomplete combustion). Pics include dioxins. Indirect thermal desorption does not allow direct contact between the waste and heat and so this potentiality cannot arise. For this reason, people assume that the latter process is safer.

alarmist, be devoid of anything that is speculative, engage and have a meaningful conversation with the stakeholder. Be receptive and open, listen...take seriously and respond to questions.

Experts understand the importance of allowing for a values frame when they explain a risk. It's *the integrity and honesty of your message to them. The essence was to be absolutely upfront.* It's about *truth, accuracy, openness and honesty and humility, not arrogance.* Information should be communicated *with great empathy and understanding...It must have a subjectivity associated with it. People ...may have certain knowledge or understanding, or even fears.* These could be a risk from *contamination...tar in sediment...(which) causes a community angst about children...playing on the beach.* Experts *mustn't deny.* They need *great empathy and understanding. If you're going to smell it, hear it, you've got to say it.* Here we see the two modes of thinking in play. The analytical mode addresses the empirical risks (*tar in sediment*) and the experiential mode allows for the expression of emotions about that risk (*community angst*). These examples suggest that experts can understand the difference between empirical and perceived risk.

Experts understand the need to keep abreast of community expectations about where information is delivered. For example, there are *many different layers ...channels...levels of communication, notification in the local newspaper or letters and email lists.* These are all ways to *try to capture the community.* Here, it is worth considering the idea that people in a community may not want to be *captured.* It could imply a negative situation around power relations, even if it not meant in that way.

To this point, I find that experts can understand:

Firstly, the nature of their target audience.

Secondly, that risk dialogues are underpinned by competing motives.

Thirdly, the importance of using a variety of platforms to communicate with their target audience.

Fourthly, that an individual's personality influences their capacity to communicate with a target audience.

7.2.2. Findings from the in-depth interviews using grammatical analysis.

In this chapter, and in Chapters Five and Six, I made findings about the language of the expert, including about their use of verbs. Now I make further findings using grammatical analysis to explore experts' use of grammar. I apply Butt et al. (1995)'s framework of functional linguistics which allows classification of text by genre, the Finite and grammatical structure. I made three groups of findings, drawing on data and expert literature considered in earlier chapters.

Genres

Let's look firstly at the representation of genres in expert texts. Butt et al. (1995) identify seven genres which support the production of "an acceptable text of any type" (p.142), and provide definitions of each. In Table 7.1. below, I draw on Butt and colleagues' seven classifications and paraphrase their words to provide accessible definitions.

Butt et al. (1995) further characterise genres as formulas with particular structural features around orientation (who, where, when, what), explanation, phenomenon, statement, classification, event, problem, question, argument, opinion and action. The literature review provides examples of expert knowledge where these features are represented, including on digital platforms. These features are also evident in data generated from in-depth interviews. Considered together, they support the classification of expert knowledge forms as genres.

Definitions of Genres after Butt et al. (1995)	
Genre	Definition
Narrative	The purpose of a narrative text is to tell a story as a means of making sense of the events and happenings in the world
Recount	The purpose of a recount text is to reconstruct past experiences by retelling events and incidents in the order in which they occurred.
Information Report	The purpose of an information report is to present factual information about a class of things usually by first classifying them, and then describing their characteristics
Discussion	The purpose of a discussion text is to present information about more than one side of an issue. It may end with a recommendation based on the evidence presented
Explanation	The purpose of an explanation text is to explain why things are as they are or how things work
Exposition	The purpose of an exposition text is to advance or justify an argument or put forward a particular point of view
Procedure	The purpose of a procedure (text) is to show how something can be accomplished through a series of steps or actions to be taken

Table 7.1. Genre 1. Definitions of genres: After Butt et al. (1995).

Narrative genre, for example provides a historical context to a contaminated site, allowing the expert to explain why a contaminant was considered benign and useful to society: For example, gas-works wastes were used to tar roads and as fill to reclaim inter-tidal zones for industrial use, and pesticide production supported higher levels of food and fibre production.

The genre Recount includes Information Reports and Discussion. It accommodates remediation site histories, allowing facts, dates, policies and processes to be presented, including via digital platforms. Examples of this genres are cited in Chapter Two's review of scientific literature which identifies expert knowledge in the form of reports and scientific dialogues about POPs.

The genres Explanation, Exposition and Procedure support discussion of POPs risk, whether it be about the degree of risk, risk guidance, technology selection, risk management, or hazard monitoring.

Chapter Two's discussion of models of risk communication (2.5.1-2.5.3) is also relevant to our consideration of genres. For example, the dialogue model of risk communication accepts the validity of all knowledge forms, including all expert genres that are relevant to people affected by POPs contamination. However, as we have seen in previous findings chapters, experts who communicate about a risk may, or may not have access to, or sufficient understanding of, the entire range of knowledge forms associated with that risk. It follows then that access or lack of access to, or understanding or lack of understanding of, expert genres about risk, limit the expert's capacity to explain what it means.

Finites

Let's look now at experts' the use of verbs. We draw again on Butt et al. (1995)'s approach which assigns verbs a foundational role in the expression of interpersonal meanings. In their schema, a verb or a verbal group (clause) is referred to as a Finite. The Finite assigns timing and motivation to the subject of any text. As Butt et al. (1995) explain it, the Finite "encodes primary tense or the speaker's opinion.....and..has two main interpersonal roles..: it can be a sign of TIME in relation to the speaker, or a MODAL⁴² sign of the speaker's opinion" (p.67). Finites are also known as auxiliary verbs.

I align findings against the two categories of Finites, one associated with time, the other with opinion. Experts use both categories. Finites expressing time allow them to explain how they are, or will reduce risks. In other words, they use verbs to express how they can act to reduce risks. Finites expressing modality allow them to explain their responsibilities around a risk, their competence to manage risk, and their capacity to act to reduce it. MODAL Finites used by experts include the following: Can, must, can be, can do, can't do, should, shouldn't, shouldn't be, could, couldn't, and might be. Here there is alignment with Butt et al. (1995)s selection of MODAL Finites, which include "must", "might", "could", "can" and "should". In their own way, each of these Finites signals how the expert, as the communicator, judges the definiteness or certainty of propositions about remediation risks. Table 7.2 below provides some examples.

⁴² Butt uses capitals when he provides the term MODALS

Experts' Use of the Finite		
Mode	Existing Findings	Examples of Risk Communication
Finite expressing time.	Experts can explain how they will reduce risks, how they are reducing risk, or what they are <i>going to do</i>	<i>Some level of confidence that whatever we're going to do <u>can be accomplished</u></i>
Finite expressing modality	When experts use verbs that convey an obligation or compulsion to act, they can acknowledge uncertainty and provide for certainty	<i><u>shouldn't</u> shy away from that.</i> <i><u>should be able</u> to say what they think</i> <i>contaminant <u>might be</u> cleaned, or <u>should be</u> cleaned up</i> <i>you <u>must have</u> a moral conscience</i> <i><u>might not have</u> done, what <u>might happen</u>, <u>might deal</u> with the problem</i>
Finite expressing modality	Experts have sufficient language skills to communicate that they are competent to manage uncertainty and reduce risk.	<i>When there's huge uncertainty, professional judgment probably <u>shouldn't be</u> used</i> <i><u>should be</u> more analysis or more robust risk calculations</i>
Finite expressing modality	Verbs have the power to convey the possibility, probability or actuality of human action	<i><u>must</u> take place</i> <i>how the body <u>might be</u> experiencing those impacts.</i> <i>you still <u>might miss</u> something</i> <i><u>might upset</u> people or raise doubts</i> <i><u>could access</u> for independent consulting advice</i> <i>Good comedy...<u>can be</u> used to create debate</i>

Table 7.2. Experts' use of the Finite

Grammatical structures

My third group of findings about expert language draws on Butt et al. (1995)'s framework of grammatical structures which provides for the overarching classification of what they term 'metalanguage'. Metalanguage is positioned as a way to interpret "the overall patterns of a text in order to see what we can uncover about its motivations and context" (p.122). In this schema, there are three classifications of metalanguage: the "Field of Discourse", the "Tenor of Discourse" and "Modes of Discourse". They reflect the "dynamic relationship between what meanings we want to convey, the

grammatical structures we use, and the context of situation which frames these meaning.” (p.141)

In this inquiry, the topic under investigation is remediation risk, and by applying the construct of metalanguage, I am able to align expert text about uncertainty with the “Field of Discourse”. Specifically, the field of experience is a contaminated site and its remediation. As to the “Tenor of Discourse”, it is the conditions under which expert texts are discussed that are relevant: specifically, the social relationship possible between expert and non-expert is reflected in the forms which social engagement take. With respect “Modes of Discourse”, it is the nature of expert texts and the language used within them that are relevant: specifically, expert content about risk and the quality of the language that explains it. Table 7.3. below provides examples of each of these classifications present in the metalanguage of ‘the expert’.

The metalanguage of ‘the expert’		
Discourse	Meaning	Application in the inquiry
Field of Discourse	The field of human experience encompassed by the text and its purpose in encompassing it	Uncertainty about contamination and remediation risks
Tenor of Discourse	The social relationship between the speaker or writer and the addressee	Forms of social engagement about remediation risks
Mode of Discourse	The nature of the text itself and the role that language plays in it	The content of expert risk knowledge and the capacity to explain it.

Table 7.3. The metalanguage of ‘the expert’

To this point, we see that expert texts can reflect the three classifications of metalanguage: field, tenor and mode. Now, I align data generated through in-depth interview against these classifications, and by this method, analyse the structure of experts’ risk discourse.

In previous chapters, we made findings about the experts’ capacity to explain key scientific terms associated with remediation and the meaning of empirical uncertainty. Here, we provide further support for these and other findings by subjecting data about uncertainty to analysis, using two of Butt et al. (1995)’s three categories. Analysis was

undertaken to explore the field of discourse and the mode of discourse, with the tenor of discourse rejected as inapplicable.

Field of discourse

Let's start with the analysis of the *field* of discourse. It is concerned with the subject, or topic of a discourse- the processes, participants and circumstances. For this inquiry, the field of experience is risks associated with contaminated sites and their remediation. I followed Butt et al. (1995)'s classifications for field of discourse data, and drew on existing data generated about uncertainty during in-depth interview. Reflection and review of that data yielded contextual descriptions that align with findings from Chapters Four and Eight, as well as from Chapter Five. Table 7.4. below provides examples of this alignment.

Mode of discourse

The second of Butt et al. (1995)'s categories of discourse is the *mode* of discourse. It concerns the nature of expert texts and the language used within them. I utilised their classifications for this mode which prescribe roles for language, including a constitutive role when language "is the whole activity", and for mediums for language which allow for language when it is spoken, written or signed. Types of interaction refer to a monologic text (one person), and dialogic for texts where more than one person participates. Channels of language is how the text was originally received, and rhetorical modes refer to the overall feeling of the text, for example, instructive or persuasive (pp. 130-131).

For the analysis, I again drew on data used in Chapter Five's analysis of uncertainty, this time using data about risk and the quality of the language that explains it. Reflection and review of data yielded contextual descriptions that align with findings from Chapters Four, Six and Seven, as well as Chapter Five. In addition, analysis identifies a constitutive role for language, a monologic interaction, a medium that is originally spoken, a graphic channel, and a rhetorical mode which is instructional. Table 7.5 provides examples of the mode of discourse.

Tenor of discourse

The other classification of discourse is the *tenor* of discourse. Its "scope is the relationship between the participants and their roles and status" (Butt et al., 1995

p.130). Tenor of discourse considers the respective roles of the speaker and the addressee, and their social distance and level of familiarity. This inquiry does not consider discourse between different groups of participants, rather it considers the discourse of the expert as reflected in transcripts of in-depth interviews, and the discourse of non-experts as reflected in transcripts of focus group discussions. This eliminates the possibility of undertaking grammatical analysis of the tenor of discourse.

To sum up, experts can construct knowledge forms that align with the grammatical construct of genre. This capacity brings forward meanings that support the process of risk communication, including about hazard, risk and uncertainty. On the other hand, experts can lack access to, or understanding of, different genres of expert text, and this limits their capacity to communicate about risk.

Experts can use verbs that express time, and thereby communicate the temporal context of an action. They use verbs to communicate their responsibilities, competence and capacity to manage and reduce risks.

Experts' language can reflect grammatical qualities that clarify the topic of a discourse, for example, empirical uncertainty, and allow for communication about professional, commercial, social and temporal contexts around empirical risk and risk selection. Contextual descriptions about empirical uncertainty provided by experts align with existing findings about risk communication and about experts' understanding of, and competence to reduce risk, their capacity to communicate that they are competent, their awareness of commercial constraints on their activities and of the ethics around risk distribution.

Field of Discourse Uncertainty about contamination and remediation risks		
Analysis. Classification of Experiential Meanings	Contextual description	Alignment with existing findings
<u>Process Type</u> Experts' description of mental processes that analyse a risk situation. <u>Data</u> <i>cannot know, debating, misjudge, might be perceived, interpret, warranting, put limits, will occur,</i>	Suggests that experts position propositions about the uncertainty of a risk situation as contested knowledge. Indicates variation in the analytical mode of thinking about the degree of risk. Experiential domain. Short term goal; risk communication with non-experts. Long term goal; risk reduction	Aligns with findings from Chapter Five Findings propose the need for balance between two modes of thinking.
<u>Participants</u> Experts identification of different groups associated with a risk situation. <u>Data</u> <i>Whoever is funding the work. Clients, the development industry, risk assessors, engineers, EPA, stakeholder, community, resident</i>	Demonstrates the capacity of experts to identify the range of participants associated with a risk discourse.	Aligns with a finding from Chapter Eight. A finding proposes that experts can understand the nature of their target audience.
<u>Circumstances</u> Experts' identification of risk situations and associated hazards. <u>Data</u> <i>Chernobyl, Homebush Bay site, Fiskville.</i> <i>Dioxins, PFOS, known knowns, known unknowns, and unknown unknowns.</i> <i>Exclusion zone, support zones, community relations</i>	Demonstrates awareness of historical risk events and contemporary risk situations.	Aligns with finding from Chapter Four. A finding proposes that experts recognise key events and situations, including milestone events.
<u>Time</u> Experts' understanding of the temporal context of risk situations <u>Data</u> <i>Not measurable at that point in time.</i> <i>A lot safer these days than they would have been 30 years ago.</i> <i>Inter-generational consequences.</i>	Demonstrates awareness of the role of technological advances in the measurement of contaminants	Aligns with findings from Chapter Four Findings propose that experts are aware that technological changes over time govern the level of uncertainty associated with pollution risks, and understand that there is a temporal context to risk.

Table 7.4. Examples of field of discourse.

Mode of Discourse Uncertainty about contamination and remediation risks		
Analysis: Classifications of textual meanings	Contextual description	Alignment with existing findings
Topical Themes. <u>Data</u> <i>the environment, environmental condition, geological, part and parcel.</i> <i>exposure pathways, exceedingly complex, the total volumes, a mass estimate.</i> <i>The context needs to be conveyed.</i>	Suggests that experts' are competent to explain the meaning of an empirical risk. Constitutive language constitutes the whole activity. Language is monologic. Text was originally spoken, then received as a set of transcripts. Rhetorical thrust: instructional	Aligns with Chapter Five findings. Findings propose that experts understand meanings around empirical uncertainty, and are competent to reduce uncertainty associated with a risk situation. Aligns with findings from Chapter Six. Findings propose that experts have sufficient language skills to explain how they will reduce risks or how they are reducing risk.
Predicators. <u>Data</u> <i>have to live with, you anticipate, do we worry, are often willing, that would be, can be, can estimate, probability, new data</i>	Suggests that experts are aware of limits to their expertise associated with risk characterisation.	Aligns with a finding from Chapter Seven The finding proposes that experts acknowledge that science can never provide conclusive evidence of safety.
Textual Themes. <u>Data</u> <i>there's a margin of error in everything you do, There's rules about processing risk, err on the side of caution, an unacceptable risk, the ultimate responsibility.</i> <i>The contingencies are too low, the cost is much greater than the estimate, should budget for more uncertainty, the projects that went wrong... clients won't want to talk about.</i>	Suggest that experts understand that factoring uncertainty into a commercial contract is an ongoing commercial challenge	Aligns with Chapter Four findings. Findings propose that experts can distinguish between the financial and social aspects of corporate responsibly, understand that there can be tension between them and that there are ethical implications when people are exposed to excessive or involuntary risk. Aligns with Chapter Six findings. Findings propose that knowledge transparency is limited by practicality, confidentiality, and commercial constraints, and that commercial factors play a role in risk selection Aligns with a finding from Chapter Seven. A finding proposes that experts understand the construct of involuntary risk.

Table 7.5. Examples of the mode of discourse.

To conclude, I find that:

Firstly, experts can exhibit variable capacity to use well-structured language to communicate that they are competent to manage uncertainty and reduce risk .

Secondly, well-structured language is useful in risk communication.

7.2.3. Findings from the Key Terms Questionnaire.

This section presents findings generated from the Key Terms Questionnaire. The terms emerged from the literature review of the biophysical sciences. There are eleven terms: density, volatility, kinetics, no-effect-level, conservative value, trigger values, weight-of-evidence approach, contamination, exposure, exposure pathway and remediation. I used them to populate the questionnaire which explores how experts use textual language to explain the meaning of the terms.

Twelve of the seventeen experts completed the questionnaire. The response rate is low and limits the power of the findings, nevertheless, I present them here.

Firstly, I analysed the data quantitatively by assessing the degree of alignment between the definitions provided by experts with those from recognised sources.

See Appendix 7.1. Key Terms Questionnaire: Definitions of ten terms from the biophysical sciences .⁴³

Three categories were selected to represent the degree of alignment between the selected and the provided definitions. They were 'Sufficient', 'Limited' and 'Non-compliant'. A fourth category was provided to record other responses. I eliminated responses to the terms "Kinetics" and "No Effect Level" from the analysis, leaving nine terms available for analysis (For explanation, see Section 10.2 "Limitations").

I find that experts can understand the scientific meaning of most terms, with all responses bar one sufficiently aligned with the selected definition (= or >6/12), and vary in their capacity to correctly define them. The terms 'density' and 'exposure' attract the least alignment (6/12), which is surprising since these are simple terms when compared with all others which, whilst more complex, attract a greater degree

⁴³ The key terms questionnaire also explored terms used in the social sciences. Results of this are provided in the next chapter.

of alignment: 'Contamination' attract 7/12, 'conservative value' and 'weight-of-evidence approach' attract 8/12 and 'trigger values' attract 9/12. More alignment is evident for 'volatility' and 'remediation' (10/12), whilst the term 'exposure pathway' attracts the most alignment (11/12). This latter finding reflects the familiarity of experts with remediation situations where odorous volatile substances are in play, ensuring that the 'exposure pathway' of these compounds is evident to anyone in their vicinity.

To this point, we have reported quantitative measures that indicate the degree of alignment between the definitions provided by experts with those from recognised sources. What can we reasonably infer from these results? Here we cross over to a qualitative analysis, using thick description to investigate whether they tell us anything about experts' use of language.

Experts use description to explain the meaning of a term. For example, 'density' is when *molecules...are very close together*, 'volatility' is around *noticeable odour* and the meaning of 'weight-of-evidence' is conveyed by the phrase, *what most of the evidence suggests is true*. Density is explained by comparison with something familiar, as when *a cotton ball is less dense than a stone of the same size*. Volatility is explained by comparison with a common solvent acetone: *Acetone.... (is) more volatile than water*, or by comparison with petrol; *petrol...(is) more volatile than oil*.

Verbs that bring the senses into play convey the meaning of terms. For example, 'volatility' is referenced to *smell and feel*, and 'exposure' to *breathing...swallowing*. Other verbs allow experts to explain the function of a term, for example, a term associated with public health protection. Take 'trigger values' for example. These are risk criteria such as *criteria set at or below an environmental standard (that are) used as triggers to review work practices that produce adverse environment impacts*. Here we see that the meaning of 'trigger values' is positioned around their protective function, and represent the point at which the expert must take action to protect public health in accordance with licence conditions. To explain how health is protected, experts select phrases containing auxiliary verbs that imply compulsion, as in *must take place*, obligation as in *would require*, or causation as in *will occur*.

The meaning of other terms is explained using the vernacular. For example, the term 'conservative values' is explained by the phrases *play it safe*, or *err on the side of caution*. On occasions, a particular way of thinking about the world is evident.

“Contamination” is *the result of man’s activity*, or results in *damage to people or ecosystems*.

To conclude, I find that:

Firstly, experts can explain the meaning of a term by using description, the vernacular, and verbs that elicit the senses, explain a function, or imply compulsion, obligation or causation.

Secondly, when experts select these attributes, their language has sufficient clarity and depth to explain the meaning of terms, as distinct from providing their definition.

Thirdly, experts can vary in their capacity to correctly define the key terms associated with the bio-physical sciences.

Following this, I undertook further thick description analysis of three terms selected on the basis that they lay in the middle of the alignment rating and represented empirical measurements integral to risk assessment and management. The terms are ‘conservative values’, ‘weight-of-evidence approach’ and ‘trigger values’ and when experts explain their meaning, they address Van Asselt and Vos (2008)’s uncertainty paradox.. They concede that science cannot prove that a situation is free of the possibility of an adverse effect and, as a consequence, that risk levels can only ever be estimates. They can explain that despite the risks they have to manage, they can provide for safety, and explain this in terms of their professional practice, which is designed to reduce empirical risks. Table 7.6 below provides examples of experts’ understanding of the meaning of terms which imply recognition of the uncertainty paradox. The use of verbs that imply compulsion, obligation or causation is critical if credible explanation about the meaning of the terms is to be achieved.

Acknowledgment of uncertainty		
Scientific Term	Examples of data	Analyst's Insights
Trigger Values	<i>Harm may be caused.</i> <i>According to established scientific evidence.</i>	Indicates recognition that science cannot prove that a situation is free of the possibility of adverse effects.
Conservative Values	<i>To account for the inherent uncertainty of the science.</i> <i>In science, a conservative value refers to a value below that which has a high chance of producing an effect.</i>	Indicates understanding of the complexities of calculating empirical uncertainty.
Weight-of-Evidence	<i>On the basis of known research, based on the most data or information,</i> <i>The body or volume of scientific evidence supports a particular claim.</i>	Reflects understanding of the scientific method.
Providing for Certainty		
Trigger Values	<i>Level of exposure, if exceeded, would require some action to be undertaken.</i> <i>Corrective action must take place, goals and limits that are set, certain actions will occur.</i>	Invokes compulsion or obligation to act. Acknowledges the potential for risk and that a situation is not free of the possibility of adverse effects.
Conservative Values	<i>Erring on the side of caution, a good safety margin, play it safe.</i> <i>An acceptable concentration of a dangerous material that is set well below what experts consider to be safe.</i>	Indicates that a situation is protective, regardless of the possibility of an adverse effect. Reflects understanding of the scientific method.
Weight of Evidence	<i>A number of lines of evidence, multiple types of independently derived or acquired data.</i> <i>Decide on a reasonable assessment of effect, using and counting evidence.</i> <i>Make a decision based on what most of the evidence suggests is true.</i> <i>Jointly considering, drawing together, developing, to determine, seems to indicate.</i>	Explains how decision-making takes place within a scientific framework.

Table 7.6. Explaining the uncertainty paradox

To conclude, I find that:

Firstly, experts can acknowledge that science can never provide conclusive evidence of safety.

Secondly, when experts use verbs that convey an obligation or compulsion to act, they can acknowledge uncertainty and provide for certainty.

To this point, we have looked at how experts use textual language to create risk messages suitable for communicating with non-experts. In the next section, I provide findings about how non-experts experience and understand risk messaging from experts.

7.2.4. Findings from the focus group.

In this section, I provide findings from the focus group about the content and meaning of expert risk communication. Participants in the focus group were asked to discuss and respond to a set of texts that provide scientific content about the origins of PFAS contamination and the risks they pose to human health. Three texts were provided and for each text, eight minutes of group discussion was allowed. Discussion was recorded and transcribed for later analysis, using thick description.

Texts 1 and 2 comprise four and two pages respectively and participants were given the option of reading through the entire text, scrutinising any selection of words, or a paragraph. Text 3 is diagram that contains images as well as text. It was selected on the grounds that the text was the critical part of the message, whilst the images were simple and descriptive, and convey little if any, additional meaning to the text. Table 7.7. below identifies and describes the three texts.

To support the analysis, I turn again to Gregory et al. (2006)'s two modes of thinking, one reflecting the analytical mode, in this case, about the characteristics of an empirical risk, the second reflecting the experiential mode about the variable meaning of that risk. Also useful was Gregory et al. (2006)'s evaluation of the importance of consistency and clarity of technical communication about risk, Scheer et al. (2014)'s construct of linguistic uncertainty, and Gustafson and Rice (2019)'s construct of "uncertainty as a message characteristic" (p.2). I drew on these theories and findings to guide the initial data classification and support analysis using thick description.

Three texts Expert content about PFAS risk			
Number	Image name	Descriptor	Source
1	Network graphic: PFAS Investigation and Management Program	Provides text and icons about the production of PFAS-based products over time	Australian Government (2019a)
2	enHealth Guidance Statement	Provides information about PFAS-exposure risks and gives guidance about reducing exposure	Australian Health Protection Principle Committee (2019)
3	E.P.A. Fact Sheet. RAAF Base Richmond: PFAS Investigations.	Update for local residents about PFAS risks and exposure pathways	N.S.W. EPA (2018)

Table 7.7. Three texts. Expert content about PFAS risk.

Let's go now to the analysis of the texts.

Text 1.

Text 1 is a text-focussed diagram about PFAS is provided in Figure 7.3. below. It provides information about the development and use of PFAS in industrial and consumer products over a sixty-year period.

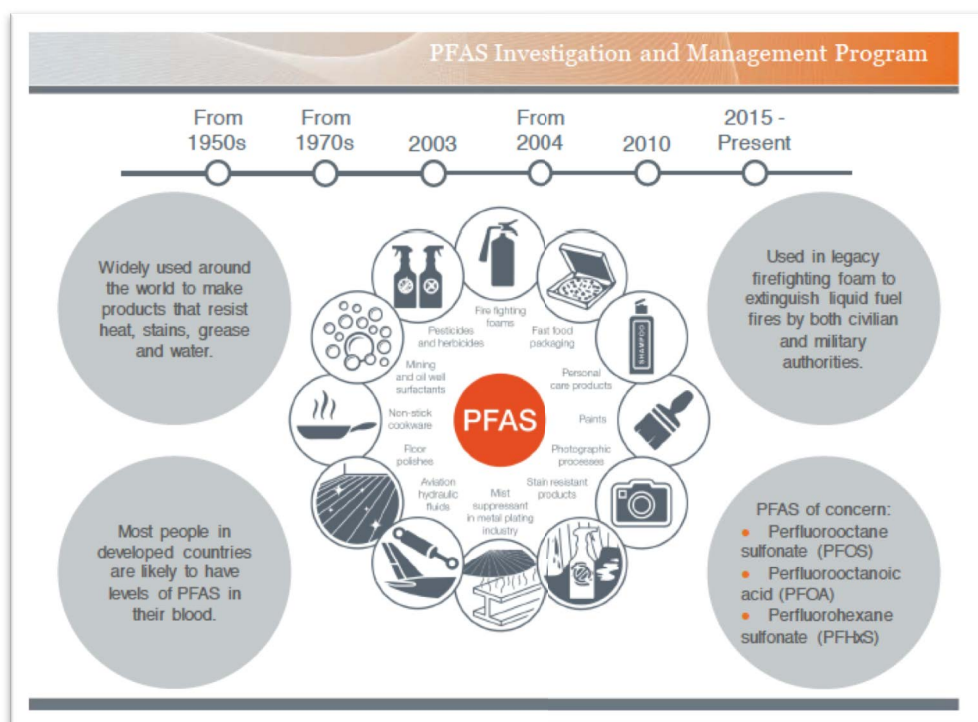


Figure 7.3. Text 1. A text-focussed diagram about the production of PFAS-based products. Australian Government (2019a)

Participants respond positively to the text, for example *whoever put this together is trying to really inform ...the audience, easy to take in, feels really well-rounded. I like the timeline and images. I've learned something from it...I have something to go with.* On the other hand, participants criticise the text. It is *not updated*, or *needs graphics to better take in*. The lack of identification of the creator of the text is noted since the text *doesn't say Defence Department, so I'll assume that it is from the Defence Department*. Participants affirm the accuracy of the text in that PFAS has a *long history. It's ubiquitous, in lots of industrial products, commercial products, personal care products.*

A participant imagines himself as someone who is seeing the message *for the first time and ..had no idea about PFAS*. In this imagined situation, that person might say *'I don't know. There's a few chemicals'. That's all it says. It makes no claims unless I've seen those kinds of things.* Here, the participant shows understanding of the influence of prior knowledge on how a risk is understood.

Responses reflect scepticism about the intent of the risk message. For example, *it gives me the impression they have been investigating and 'managing' since 1950s*, or it might be aiming to communicate that *everybody's got a little bit of PFAS in their blood, so if you get some more, what's the big deal? They are trying to diminish their responsibility using language. It's.... putting doubt out there, that maybe if the poison's not coming from them, it might be coming from someone else.*

A participant questions the use of the word 'legacy'. She asks *why "legacy firefighting foam"? Legacy is the charity. It's trying to make you think that it's a good thing. So it just really makes my blood boil.* Here we see an example of the use of a word in a way that is unacceptable to the reader because the word has a distinct and unique meaning to her.⁴⁴ In the next section, we will discuss this situation again when we explore non-scientific uses of the scientific word 'toxic'.

Participant responses indicate that they understand the scientific concept of exposure pathways. *The degree of exposure is key.* However, they are less than satisfied about

⁴⁴ In Australia, the charity Legacy was established after World War One to assist the widows, widowers or children of deceased or injured servicemen and women. It remains an active charity and is widely respected for its good works.

how this concept is represented. For example, *I don't see any indication of what levels, or the direct pathway to any people. PFAS is in ..a shampoo ...how long does it take if it's sitting on your skin to get in. How is it toxic?* Another responds to the text with humour when he asks *How many pizza boxes would you need to eat to get a level in your system?* One participant recalls how she got very sarcastic.... *They told me that the contamination was worse in my chickens than it should be, implicating that it was my fault. I said, 'Oh, yes, yes. I feed my chickens firefighting foam, and I feed them out of Teflon pans.'*... *I just got really upset.*

Another participant is more sanguine about the potential for exposure: *Obviously there's things that we might use, but ... why is it worrying us? How many people have a fire extinguisher in the home and how many times have you used it? They go out of date before you do anything.* This response aligns with Luhmann (1979)'s idea of the "wary indifference" (p.22) of people when faced with an indeterminate risk, or with Evans and Plows (2007)'s notion of the disinterested citizen.

Responses to the text reflect concern, worry or anxiety as proposed by Taylor-Gooby and Zin (2006, pp 402-405.) and Prior et al. (2017). For example, the PFAS situation is *pretty scary. Most people got it in their blood. It's everywhere. It could be a bit of a ticking time bomb. Because ...there's so many different paths of waste, PFAS could go anywhere and everywhere.. It might go off our bodies in our soap, down our drains, but then come back to us from the vegetables we've watered from our grey water. It's insidious.*

Responses show awareness of other PFAS that are not mentioned in the text, suggesting the presence of the active or scientific citizen as proposed by Owens (2000) or Irwin (2007). For one participant, the text stimulates his memory about *the first picture they produced for me. It had very few things around that PFAS circle, and it's been growing and growing. And I made it grow even further by investigating.* Other responses are similar. *Some of the most contaminated things that they don't even mention are things like microwave popcorn and the fish swimming in the contaminated rivers that you eat...In the United States they've actually linked water as the number one transport of PFAS.* These comments prompt another participant to ask *what's wrong with ...microwave popcorn?* Her question is answered by another who explains

that *they line the bags with the PFAS compound because it's oil proof and water proof. You then put it in the microwave at a high heat and the PFAS gets into the popcorn.*

As well as knowledge about the presence of PFAS in home and community, participants show understanding of the relationship between economic and political processes. *I noticed that they're getting rid of old stock. Lots of Scotch Guard on special offer in Aldi. Scotch guard is a big contaminant. I've discovered (that) the industry is responding much quicker...When I first started looking, there was no labelling on saucepan or fry pans or ...cookware. ...I found one in Aldi, and I got all excited. It actually had "PFOA- free" on it. Now you can get them everywhere.*

To this point, analysis suggests that non-experts understand the health implications of exposure to PFAS, and can be involved actively in preventing exposure of themselves and others. In this way, they are acting within an ethical frame, which is also evident in their expressed concern about the failure of regulators to apply *the precautionary principle*. They see people as *the guinea pigs*, and consider that *things should be tested first before they are released on the unsuspecting community*. They foresee problems ahead for current generations of younger people who are *going to have problems*. The oldest participant is resigned to the situation when she says *it seems like this is the modern world*.

Text 2.

Text 2 provides information about PFAS origins, use, the potential health impacts, and the meaning of reference values and blood tests. Figure 7.4. below shows the identifying logo and text at the top of the document.

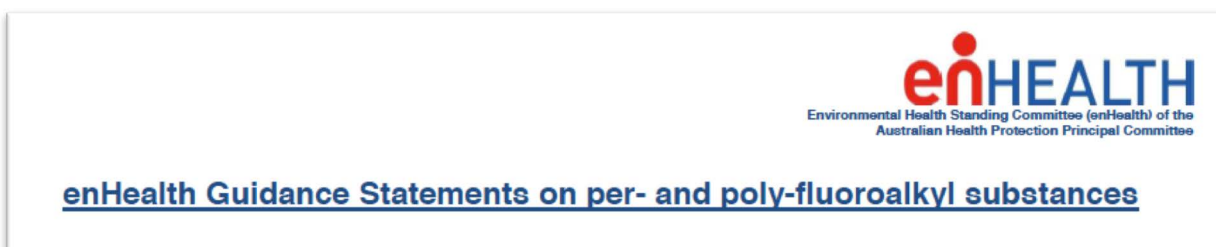


Figure 7.4. Selection from Text 2. “enHealth Guidance Statement” Australian Health Protection Principle Committee (2019).

Participants distinguish features of the text, including the logo, specific areas of health risk information, potential exposure pathways and the word “precautionary advice”.

They find it useful because it filled information gaps. For example: *I do really like what they've produced. I've learned something. I didn't know that PFAS came from all sorts of ...hair shampoos. If I didn't know anything about PFAS I would have read this and found it interesting. It answers a lot of questions that people have. It's aimed ... to provide information that's really understood without being too technical, but technical enough to give assurance that they know what's going on.*

Here, the responses indicate confidence in scientific information, including because it is updated as new evidence emerges. For example, *they have updated their health effects. They kept telling us there were no health effects, and now they've put in that there are some probable health effects. They've been telling that there's nothing to be concerned about, and there's no consistent evidence of health effects, so they've obviously updated this ...to say that there are health effects, which is good.*

On the other hand, participants consider that the information in the text omits new scientific information. For example, it does not include *many of the things which we know it's in. ... Weather gear, snow stuff, all your snowsuits.... your mascara. They don't have the ingredients of what's on the baking paper. It's in a lot of baking paper...so that things (are) non- sticky, and it can come off. They haven't put that in.... haven't updated all the things that PFAS is in. Health (N.S.W. Department of Health) has ...not updated it as more things come to light. They need to put all those down. It's very difficult for us as lay people to know what to avoid. I think they should be telling us, that it's in our food... and you don't know.*

One participant mentions *the difficulty is in assessing and communicating potential risk*, which brings forward the issue of the inherent limitation of scientific evidence.

Participants understand the limitations of scientific evidence. They recognise that *blood tests cannot determine if the PFAS levels in a person's blood will make them sick now or later.* One participant is familiar with a report by an Australian government expert PFAS health panel, and points to the mixed message about PFAS risk it contains. The report claims that *that there is no current evidence to suggest an increase of overall health related to PFAS exposure...and also said the health effects cannot be ruled out at this time. What are you saying? There's no current evidence? There's no current evidence when you don't look for evidence. There's no evidence to say it doesn't affect you. They cannot rule that out. But the wording is always that 'We*

don't have conclusive evidence that it's going to kill you, but we don't have conclusive evidence that it won't kill you.

Other responses are even more sceptical. *The language is that they're in control. So rightly or wrongly, they're giving the impression that they're on to it.* Regarding who is 'they', participants are unsure who created the document. *I need to know who enHealth are. Are they a part of the Department of Health? My first reaction is 'who is enHealth?' I noticed ...the letterhead... had . a little description of how they fit into the Department of Health. In order to take in this information, I ...want to know who's giving me this information.*

Another response to Text 2 is 'worry'. A participant feels *a bit unsettled* after receiving new information about PFAS exposure pathways, *because I don't know enough about any of this till today. I need to know more.* Another expresses frustration explaining that *they say 'just don't worry about it'*, aligning with Prior et al. (2017) finding that lack of credible information about risk that can cause people to worry.

During group discussion, participants identify PFAS blood tests as an issue, and people have different experiences. Those who came from the host community of Richmond are unsatisfied with the blood testing regime on offer, whilst those from the guest community of Rhodes had a positive recollection of previous blood testing. A participant from this latter group explains that regarding *dioxin... we were all tested three times, at the beginning, in the middle, and at the end. When we had those blood tests, I felt confident that we were all right. We knew that there was dioxin there. Tests (were for) all different age groups We were tested against.. the blood bank samples ...and we were all below.* By way of reply, a participant from the host community explains that *they won't give us blood tests because we're not contaminated enough. They say we don't even have a PFAS affected area, so they won't test it. It costs you \$660 (to organise your own blood test).*

Petts (2008) proposes that healthy scepticism is useful during risk communication, rather than a state of mind that undermines it, and participants' responses to Text 2 support this. Scepticism is expressed around knowledge provenance and knowledge ownership. For example, *they don't have any links to any scientific reports, ... they can just choose whatever they like to put in there. There's no references to any studies. That's one thing that I would like to see...who gave you the information? ...We've been*

given tons of information, then told that that's how it is, without the actual science behind it. Did Defence pay for this report, or is this independently audited? If anyone hands me anything now... can I verify any of that straight-up? We're not getting information given to us by a reliable source. ...we only have one side. I know research grants are given out. You need to go back a really long way to see who's funding the research ...to see if there's not a vested interest. It's taken me a while to come to these realizations. I question everything now. I'm interested in this topic, and I will read all that's there. We all have smartphones. We can ... go, 'Hang on a second. One participant had access to a text in hard-copy form but recalls that when he saw it originally, ...I tried to Google it ... and ... couldn't find a trace of this on the internet. It had only been given to me in hard-copy for a reason or something. Here, as with Text 1., participants' responses to this text reflect Owens (2000)'s active citizen, as well as Irwin (2007)'s scientific citizen.

At this point, we can say that sceptical responses provided by the participants need not imply complete distrust, rather they could indicate the presence of critical trust, as understood by Pidgeon et al. (2007). Responses also suggest that participants are exhibiting a degree of social literacy, defined in Chapter 3, Section 7.1. as the capacity of individuals to understand psycho-social and socio-political aspects of a phenomenon or situation.

Participants have useful ideas about how to improve Text 2. They explain that *it's too hard for anybody else to take in*, or that it *needs something more palatable to the eye for people to actually welcome this information*. By way of remedy, they suggest how to increase the public uptake. *It needs context, references/sources, and graphics to better take in. The finishing touch to it would be if it was... well-referenced. But it's probable that you could trust the Health Standing Committee. Probable, but again, it's good to have that certainty.*

Regarding distribution of expert content generally, one participant suggests that *if you're giving out information, it needs to be on the web as well so people can reference to it later*. Here, the participant invokes a citizen's right to access expert information through digital media. Using the world wide web allows lay people access to a wide variety of expert content, including historical content about PFAS risk. By accessing historical content, non-experts can come to appreciate "the mitigatory gap", described

by Edelstein (1988/2004) as “the time that passes between when the exposure is discovered, and the determination and execution of corrective steps” (p. 168). As one participant explains, *the silliest thing is, this is not a new thing.... We haven't really learned from 50 years of contaminating ourselves that maybe we should just be a bit more cautious about what we do for a start! We should be erring on the caution side and say, 'Listen, it's best not to have any in you until we can prove otherwise.' So with any of these sort of chemicals we should be pulling them aside, and saying 'guilty' until we can 100% prove that it's safe.*

Text 3.

Text 3 provides an update for the community information about PFAS investigations on the RAAF Base Richmond, N.S.W. It identifies possible health risks due to contamination of the environment, and gives guidance to local residents, including about the risks of eating fish caught in local waterways. Figure 7.5. below shows the text at the top of the document

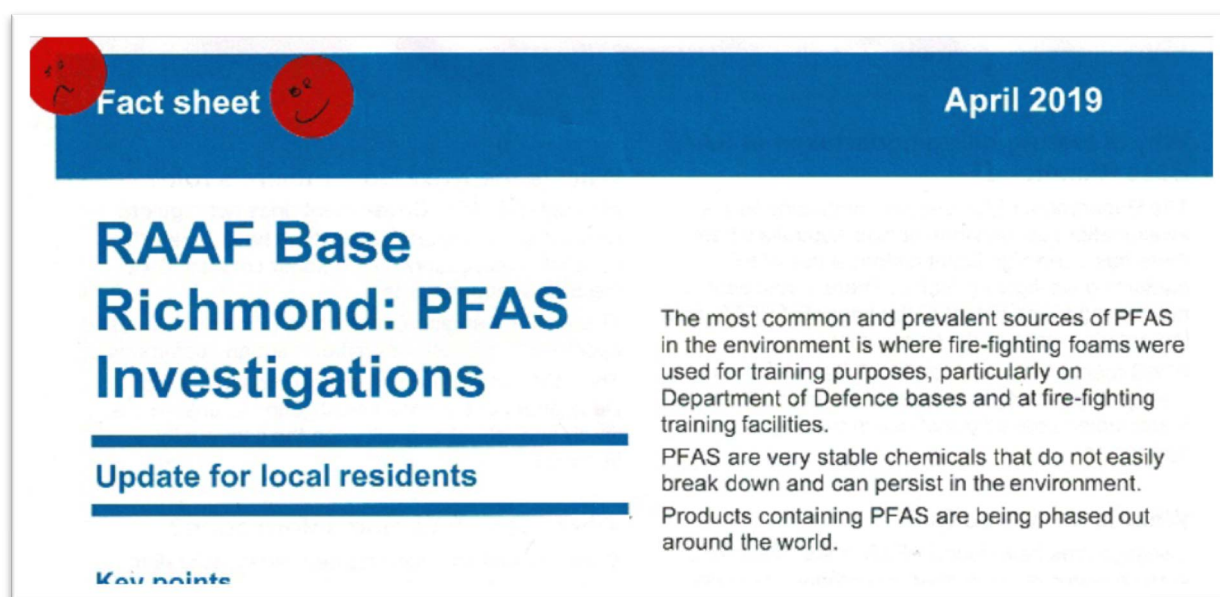


Figure 7.5. Text 3. Non-expert annotation of the words “Fact sheet”.

Participants indicate features of the text of interest to them by using red dots. Features include the logo, specific areas of health risk information, potential exposure pathways and the word “precautionary advice. As shown by the annotation in Figure 7.5. above, participants both approve of, and are disappointed by, the information in the text. One participant signals approval by using a face that is smiling, and the other signals

disapproval using a sad or worried face. This suggests that the risk message within the text could be either effective and lacking effectiveness.

On the plus side, participants approve of its content. For example, *what I like about this document is that it clearly says that this is a fact sheet. It would be useful to me as a resident. The headings are really clear, ...answering questions that I have...about fishing in local waterways.* On the other hand, whilst *there is truth in it... (there are) no facts on ...the runoff water from the base. A very general kind of a publication. They're ...skirting around the facts. There's no levels, there's no numbers except for phone numbers. It just feels cavalier. You need to know if PFAS is in you to know if you should be concerned or not. That's where we needed those actual numbers. And if we don't, we have data gaps. Fill the gaps. It still seems to be uncertain about everything.*

Here we see evidence of the tendency of the non-expert toward self-reliance and self-preservation, as well as a measure of scientific literacy. Other responses suggest the same. Take, for example, the following participant's understanding of empirical risk and exposure pathways. It is sufficient to identify something of the range of potentially risky products, if not their full extent. *It's all to do with dosage. Is it at the supermarket... at the green grocer's? Where am I supposed to limit my intake? Is it in the air, in the town water? You know (Text 3.) says "Limit Exposure", but how can I limit exposure if I don't know where to limit it from? If I know that there's a level 1ppt ⁴⁵ in the town water, and I'm already highly contaminated...Will that keep my levels going up... or can I start to drop (PFAS levels in blood).*

Another response suggest scientific literacy when a participant reveals an ability and the confidence to question the credibility of expert content: *One of the things that I always notice in these reports is that they refer to the consumption of ..brought- in produce. (This) is misleading, because these commercial farming enterprises...are affected just the same as home grown produce would be. But they never actually mention those producers. They always refer to 'home grown.'*

Information might not engender trust. Text 3 *looks really good and fancy, and there's a lot of information there, ...but it doesn't necessarily mean that you can trust that all of that is true and accurate. You need to consider who's produced this. And why,*

⁴⁵ ppt stands for 'parts per trillion'

potentially. Maybe we are being cynical, but I think that it's good to be like that a little bit. Here we see alignment with Petts (2008)'s construct of provisional trust, lying "somewhere on a continuum from total cynicism to complete acceptance" (p.825). These responses align readily with the construct of healthy scepticism, something that is useful during risk communication, rather than a state of mind that undermines it.

A participant from the visiting community of Rhodes expresses a level of trust in the creator of Text 3. *The EPA...(are) obviously here to help. We actually had EPA people on our committees... I trusted some people more than others.* For this participant, trust is connected with confidence about the quality information about risk: *Since PFAS is new to me, (I require) info which I could trust. Trust is the main thing...for me to form confidence.* Another participant also connects the quality of information with confidence in its creator. *It's obviously information that's designed to allight people's fears and concerns...trying to give assurance. It's giving confidence that we're on top of this, that it was a thing of the past that we don't do anymore.*

Participants from the host community explain that their recent experience of PFAS contamination had led to distrust in government. *Our experience is that we couldn't even get dust monitored and they wouldn't test our animals. So how can you be saying that it's this or that, if you don't even know. We don't know ...how long people have lived in Richmond. You drink the water, you breathe the air- if you've got quite a level, then.. it might be a problem. But if we don't test you, you don't have a problem.* Here again, we see awareness about the question of evidence. These participants understand that lack of evidence of exposure is not sufficient proof that there is no exposure. In this situation, this occurs when no blood tests are taken and hence no evidence of exposure exists in the form of test results. Moreover, if blood tests are taken, they might be less than helpful to highly exposed people if the results are averaged to represent the cohort that has been tested. As a highly exposed participant understands *it's all manipulation of numbers. So if we're taking an average, it'll say anything. Or not. My level (is) at 20 times higher than the average, ...so I'm way high (whereas) a lot of people will be absolutely minuscule. I want some hard evidence and data. What are the risks? That's a mandate for me.*

These responses suggest, as before, that non-experts can act as active citizens, this time by learning about contamination and endeavouring to protect themselves from

exposure, and by campaigning to get government investigations to assess the level of risk. Another example of the presence of the active citizen area is suggested in responses to the lack of disclosure about the potential for contamination of land advertised for sale. Members of the host community annotate the word 'Precautionary Advice' and comment that *it's all buyer beware or leaser beware. Nobody is telling anybody that you might be buying contaminated land...When we went down the lowlands* ⁴⁶ *the other day, there's For Sale signs all over the place... . Council is not getting involved. They won't say a thing. You need to go and investigate, and make sure you're not buying contaminated land.* One participant provides it as an example of the precautionary principle *..not really working.*

Responses reveal ethical concerns about the production and use of hazardous chemicals. It is *one of the big major problems that we need to really deal with. The chemical world makes the chemicals and release them on the community We're the guinea pigs and they don't withdraw them until after they're found to be a problem. That shouldn't happen. Things should be tested first before they are released on the unsuspecting community. Why aren't these chemical people required to do the testing before they release them onto the world? That's one of my big things. That really upsets me when they do that.* Again, as before, we see allusion to the mitigatory gap (Edelstein, 1988/2004), and one participant understands why it might happen. *We tend to just jump in and use stuff long before we really know. Probably someone in the back room knows there's some doubts about this, but (thinks) 'let's just run with this anyway' because again...their profits are far more important than the risk. In this case...it's proven ..they haven't done enough. If you would err on the side of not making a lot of profits of course, that has implications in terms of the economy .. It means we probably wouldn't have a lot of the things that we have now, too, quite frankly, to be honest.*

The presence of the active citizen is suggested when participants express shock and worry about the risk message regarding fish consumption. Figure 7.6. below shows these feelings via annotation using an exclamation mark.

⁴⁶ The lowlands comprise extensive areas of grazing land that are directly in the path of the PFAs migration from the RAAF Base Richmond.

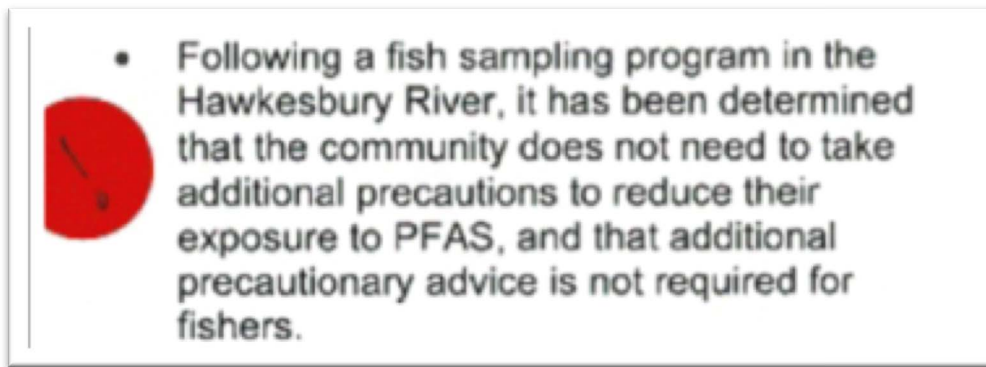


Figure 7.6. Text 3. Non-expert annotation of precautionary advice.

A participant finds that the advice that "additional precautionary advice is not required for fishers" ...(is) really shocking ...Other documents that the government has produced- there's a human health risk assessment -says that we should be concerned about fish in the Hawkesbury River.... The one thing that I would like to put out is there are precautions people need to take with catching fish. I don't think many people would be aware that there actually is advice to not eat too many fish caught from the river. So that's conflicting advice. ... makes me worried that people will read that and go, "Oh great, I can still fish!"

At this point, we have explored the responses about the content in Text 3. Let's now turn to responses about its design and distribution. The text is *very short and concise*, and *the layout of this fact sheet* (makes it) *much easier to read than the previous one*. ..*The headings* (are) *clear, blue bold writing, appropriate titles*. The heading at the end is *especially* useful since it provides links to other information sources. *I'm pleased with how this is being presented to me*.

The distribution of Fact Sheet is considered inadequate. For example, as *one of the people who have been affected by the PFAS contamination*, I would have liked to have seen this sent out to us. This is the first time I've seen this. Similarly, other communication is found wanting. *If we're talking about the way the RAAF Base communicates with the community*, my perspective is that they've tried really hard not to communicate with the community. Despite staff visiting her home to collect eggs for PFAS testing, a participant explains that *they never personally told me that there were any information sessions*. I missed ...*two information sessions*, and yet they were communicating with me about the contamination.

Here we see that experts can fail to communicate but one participant recalls *when we had that session with (a local academic). He explained stuff beautifully in layman's terms.. . He said difficult, confronting things in a way that weren't difficult...(or) ...confronting for the people, and didn't point blame. Although he was saying that the RAAF Base was responsible, he didn't actually say it in so many words.* In other words, effective communication depends on the expert's capacity to explain risks to non-experts, and at the same time, maintain their professional integrity.

To conclude, I find that:

Firstly, non-experts recognise that expert risk messages can be informative, accessible and useful.

Secondly, non-experts recognise that expert risk messages can contain inconsistencies, be misleading, inadequate or inaccessible.

Thirdly, non-experts can provide an ethical frame around the meaning of risk messages.

Fourthly, non-experts can apply scientific and social literacy to interpret the meaning of risk messages.

Fifthly, non-experts can apply critical or provisional trust to interpret expert risk messages.

Sixthly, experts need to apply design and content criteria to any text before they post it on digital media, or use it during risk communication with non-experts.

Now we can go to the final set of findings about textual language.

7.2.5. Findings from the media survey.

In its original scientific form, the term ‘toxic’ describes some of the harmful properties of substances, including substances that can contaminate land.⁴⁷ As explained in Chapter Two, risk assessors rely on epidemiological and toxicological data to calculate the extent to which a substance is toxic, use exposure standards and other measures to estimate the degree of risk that a toxic substance could pose if present on a remediation site, and select risk levels that aim to be protective of the local community.

To generate credible risk knowledge, experts require consistency in the meaning of scientific terms, including the term ‘toxic’, but in other domains, in the absence of any unifying principle, people ascribe different meanings to this term.

In this section, I provide findings about linguistic uncertainty as proposed by Scheer et al. (2014). They were generated from a content analysis of a survey about the use of the word ‘toxic’ in the mass print media. Analysis began with the classification of data that contained the word ‘toxic’, followed by thick description analysis. The results were then aligned against one of the integration mechanism named in Chapter Two as ‘improved communication through language’.

Two classifications emerged from the first stage of the content analysis. The first classification was the issue discussed and they ranged from financial management, wage reform, through to the quality of a film, vaccination and drug taking. The second classification was the subject domain. Domains range from public health, national and international politics through to sport, culture, and entertainment. These domains suggest that there are extended domains of meaning of the word ‘toxic’ beyond its original representation in the bio-physical sciences. I call this the migration of meaning. For the term ‘toxic’, extended meanings tend to convey negative impressions of situations, events and public figures, for example. ‘toxic companies’, ‘the toxic transmission of fake news’, ‘the toxic shadow of the woefully skewed anti-vaxxers’ or ‘the once toxic former prime minister’. ‘Toxic cheesiness’ is the only example where

⁴⁷ The Australian *enHealth* Council does not define the word ‘toxic’ as such, rather defining ‘toxicity’ which is referred to the ‘inherent property of a chemical to cause an adverse biological effect.’ *enHealth* Council. (2012). *Environmental Health Risk Assessment. Guidelines for assessing human health risks from environmental hazards*. Commonwealth of Australia.
[https://www1.health.gov.au/internet/main/publishing.nsf/Content/A12B57E41EC9F326CA257BF0001F9E7D/\\$File/Environmental-health-Risk-Assessment.pdf](https://www1.health.gov.au/internet/main/publishing.nsf/Content/A12B57E41EC9F326CA257BF0001F9E7D/$File/Environmental-health-Risk-Assessment.pdf)

the extended meaning does not convey a negative impression, rather a light-hearted one.

Table 7.8. below provides examples of extended meanings of the word 'toxic' and their respective subject domains.

To this point, I find that:

Firstly, the word 'toxic' is used in a range of subject domains external to the bio-physical sciences.

Secondly, use of the word 'toxic' in extended subject domains constitutes a migration of meaning.

The question is whether extended domains of meaning of the scientific term 'toxic' could confound communication about empirical risk. Let's consider another scientific term where the potential for this could be high. At the end of Chapter Four, we found that experts' favourite colour is blue, described by one expert as *nice and conservative*. The meaning is unclear here, since it might be that the expert is referring to political alignments, or to the scientific rigour that is required to support remediation processes that are safe and effective. The point is that in the scientific domain, the term 'conservative' refers to acceptable levels of risk as calculated empirically, for example, using measurement of toxic substances in blood. In politics, it has other meanings, including around a person's approach to life, or their political affiliation. To address this possibility, I applied the integration mechanism, 'improved communication through language'. It allows that:

- The meaning of words varies according to one's worldview.
- Consistency in the meaning of technical terms is important.
- New terms and multiple terminologies can confound communication.
- Language might or might not function as an integration mechanism.
- Language may acquire symbolic value when the meaning of a word becomes positioned within a broader frame.

The migration of meaning. Variation in the use of the word 'toxic'				
Date	Media Source	Issue discussed	Phrase Used	Subject Domain
1/2-3-14	Weekend Australian	Financial management	<i>inoculate your portfolio against toxic companies</i>	Financial services
2015	Newsweek	International wage justice	<i>Toxic Fashion</i>	Economics
2015	The Australian	Welfare and tax reform	<i>Julia Gillard....the once-toxic former prime minister</i>	National politics
23-7-15	Daily Telegraph	Quality of a feature film	<i>Toxic Nazi collaborator</i>	Entertainment
29/30-10-15	The Australian	Quality of a feature film	<i>Toxic cheesiness</i>	Entertainment
4-2-15	The Advertiser	Drug taking	<i>It's as if we are faced with some sort of horrendous toxicological terrorism</i>	Public health
24-1-16	The Australian	Nationalism	<i>Australia Day is a sickening display of jingoism and toxic masculinity</i>	Culture
30/31-1-16	Weekend Australian	Corporate sporting scandal	<i>to remove "toxic" logo from all their branding</i>	Sport
2/3-4-16	Weekend Australian	Institutional Reform	<i>victims of a toxic industry culture are surely the workers</i>	Institutional power
21/22-5-16	Weekend Australian	Electoral demographics	<i>journalists talked about "toxic" politics</i>	National politics
4-8-16	The Australian	Choice of UN Secretary-General	<i>the political culture of the UN is so toxic</i>	International relations
24/25-9-16	Weekend Australian	Same-sex marriage	<i>[Christian]...beliefs are toxic</i>	Sexual politics
7-12-16	Sydney Morning Herald	Conflict in a political party	<i>[One Nation] had a toxic culture</i>	Political culture
7-12-16	Sydney Morning Herald	Role of social media in a 'post-truth' era	<i>the toxic transmission of fake news and information by social media</i>	Media communications
17/18-12-16	Weekend Australian	Climate change policy debate	<i>Conflict over climate policy is set to become toxic</i>	Environment
7-2-17	Daily Telegraph	The state of political debate	<i>Toxic identity politics</i>	Political culture
16-2-17	Daily Telegraph	Vaccination debate	<i>toxic shadow of the woefully skewed anti-vaxxers</i>	Public health
1-3-17	Daily Telegraph	Inter-personal relations	<i>It's a toxic environment</i>	Identity politics

Table 7.8. The migration of meaning: Variation in the use of the word 'toxic'

The migration of meaning of the word 'toxic' could allow for these possibilities, for example in situations where experts need to explain key concepts to non-experts that are associated with it, such as risk and uncertainty. If the non-experts understand the word 'toxic' in different ways to experts, and if they associate it with situations, events or action beyond the realms of science, then when experts use this word, it's meaning could become confused in non-experts' minds, and potentially change the frame of a risk dialogue. The literature supports this possibility. Botterill and Mazur (2004) propose, for example that misunderstanding about the scientific meaning of risk might have implications for decision-making under conditions of uncertainty. They argue that the "older idea, that risk is essentially a wager has almost disappeared from common parlance ... From a complex attempt to reduce uncertainty, it has become a decorative flourish on the word 'danger' ... The outcome ... is that that the word risk 'has been pre-empted to mean bad risks'" (p.2). These researchers are less than keen on this new meaning, proposing that "our political discourse debases the word" (p.2).

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To conclude this section, I find that:

A migration of meaning of a technical term creates an unstable linguistic context associated with negativity within which experts must function.

Let's now conclude this section on textual language by presenting the overall findings.

7.2.6. Overall findings about textual language.

To conclude, I find that:

Firstly, textual language with particular attributes is required to explain the meaning of hazard, uncertainty and risk, and to explain the relationship between risk and benefit.

Secondly, the quality of expert language (how the knowledge is explained) matters as much as its content (what knowledge is selected).

⁴⁸ The authors are quoting from 1) Graubard, S.R. 1990. Preface to the issue "Risk". Daedalus 119(4): v-vi, from Douglas, M. 1990. Risk as a forensic resource. Daedalus 119(4): 1-16., and from 2) Douglas, M. 1992. Risk and Blame: Essays in Cultural Theory, Routledge: London. Page 18.

Thirdly, attributes of textual language useful in risk communication include description, example, comparison, analogy, a narrative technique, the vernacular and auxiliary verbs.

Fourthly, experts can vary in their capacity to use textual language, with some sufficiently competent to do so, and others less competent.

Fifthly, the use of the word 'toxic' in extended subject domains has the potential to confound risk communication.

The findings reflect the extent to which experts have command of their own language -- their native tongue, and assist to answer the first research question. They do this by providing evidence of experts' capacity for textual language that can explain the meaning of key terms associated with empirical risk and perceived risk.

Let's now consider the other language form that experts use to communicate empirical risk, beginning with a review of the literature.

7.3. Literature of risk communication: Non-textual Language.

Research suggests the value of visual representations in the communication of scientific and other forms of knowledge. (Barnaud et al., 2013; Bessel et al., 2007; Estrada & Davis, 2015; Wells & Meirelles, 2015). These researchers propose that effective communication requires the use of imagery, and its use in the creation of public posters is evidence of its value (Flood, 2012). Priest (2015) proposes that visuals "are a key aspect of how scientists communicate with one another and with broader audiences"(p.3), and experts use them to explain risk management or technology selection, for example Holmes Air Sciences (2006), Thompson et al. (1992) and Haninger et al. (2014).

That imagery can be useful in communication is hardly a new idea, including communication about scientific content (Frankel & DePace, 2012). McLuhan and Fiore (1967) and Berger (1972) pioneered new thinking about the role of visual representation in the modern understanding of the world, and since then, this area of interest has grown to become a domain of knowledge in its own right. Priest (2015)

observes that “in today’s ‘new media’ world, visual representations of science are more pervasive and varied than ever before”, and stresses the importance of “design principles” (p.4). McCandless (2009) acknowledges the value of visual representations of concepts and situations. In his schema, information can be beautiful if it combines text and imagery in an artistic way. In explaining cancer risk for example, he offers a set of words bounded within a circle to represent the degree of risk of “things that’ll give you cancer” (pp.154-155). He provides examples where maps are used to communicate specific messages, showing the capacity of this communication technique to represent a range of situations. (pp. 162-163, pp.218-219, pp. 190-197).

Severtson (2015) might allow that ‘information is beautiful’ when she finds that there are “visual features that foster comprehension by supporting bottom-up processing and by resembling what they are intended to represent (are iconic)”. Bottom-up processing is an unconscious mental process that connects the visual stimulus of the retina directly to cognitive processing areas of the brain (p.61). Severtson (2015) proposes that visual features of this type “may be especially effective for meeting risk communication goals.” (p.83)

Researchers argue that an uncritical reliance on the use of imagery can be counter-productive. Barnaud et al. (2013), for example, show what can happen when non-textual language is designed without considering the needs of the target audience. They question the common assumption that the more realistic a visual representation, “the more the stakeholders will feel at ease with them because they are closer to their everyday life” (p.150), and point to a lack of data, for example about the pros and cons of using maps in participatory processes. They find that when maps are too realistic and explicit, they can increase, rather than decrease divisions between different groups who are in negotiation about something, and “impede the exploration of innovative and integrative scenario (p.151). Similarly, Visschers et al. (2008) find that visual representations may confound cognitive processes by stimulating “people’s gut feeling about a risk” (p.219). Their research points to the power of specific photographic formats to elicit recall of mental imagery, something that the advertising industry has used to great effect for many years, as Ogilvy (1963)’s confession as an advertising man attests.

Estrada and Davis (2015) address the design issue when they identify two impediments to the effective use of “visual elements”, or as they call them, “multimodal texts’. (p.141) Firstly, they note that visual material is typically treated as an add-on rather than an integral part of the whole, and secondly, like Barnaud et al. (2013) they find that “there is a lack of identifying target audiences and refining visual elements for them specifically.” (p.140) Their solution involves the application of “theory and practice from the discipline of design”, and identify organising principles around composition, abstraction, colour, layers and refinement, (simplifying and editing). (p.146) When these features are built into a visual representation, they, “unlike words, have the capacity to communicate complex and complete concepts instantaneously to a larger number of recipients” (Estrada & Davis, 2015 p.145).

Here, we can appreciate that using the right colour, shape or pattern is helpful in science communication because it stimulates the imagination. Bessel et al. (2007)’s argues this when explaining that a technique called photo language “has the capacity to stimulate an individual’s imagination, memory, and emotions while providing an opportunity to articulate an individual’s thoughts by speaking through photographs using rich descriptions and imagery.” (p.558) In this way, images can stimulate the experiential mode of thinking, but as Gregory et al. (2006) proposes, images can also be processed analytically. Similarly, Wells and Meirelles (2015) observe that “visualizations can be designed to enhance human understanding of data, and visual representations of abstract data can amplify cognition.” (p.36)

To conclude, literatures from the social sciences and information design identify approaches to risk communication that have potential to improve communication between different epistemic groups, and by this means, bridge communication gaps.

7.4. Findings about risk communication: Experts' use of non-textual language.

In this section, I provide findings about the non-textual language that experts select to explain scientific content about empirical risk. For this inquiry, non-textual language is predominantly in the form of images, and I refer to it as visual language.⁴⁹ Non-textual language also includes artefacts.

Findings emerged from the analysis of data generated during in-depth interviews, from an image survey and a focus group.

7.4.1. Findings from in-depth interviews.

Words and writing don't cut the mustard these days. It's got to be graphics.
Remediation expert.

Prior to the interviews, I invited participants to bring examples of imagery with them. When they did, I asked them to describe what they brought and why they ranked it in the way that they did. Six experts brought imagery and commented on its quality during interview.

Imagery could be of poor quality, for example, *a mud map....was probably a silly one, an enhanced map is a stupid map. What doesn't work (is) huge massive data in a table. A flow sheet is a bit hard to see. The bit that had all the red lines over it was the scrubber*⁵⁰*.... As far as the community was concerned, we had a scrubber and a stack and that's all they really needed to know.*

A photo was taken to record that the company was engaged with the community but it showed the opposite. This photo showed *a stall at (a) ...shopping centre. We only had one visitor. To me it was an indication of community interest which is zero.*

⁴⁹ Non-textual language is a broad term and can also refer to cultural artefacts such as art, in the form of paintings, music and poetry.

⁵⁰ A scrubber is a vessel used to remove contaminants such as dust, acid or organic compounds, from an industrial air stream by contact with water. Pers. Cor. J. Hunt, 2nd September, 2020.

Imagery such as *pictorials of what is a risk assessment, or that cartoon the US EPA published* can be useful. *They are two very topical examples of what worked.*

Experts recognise the value of posting a range of images on a website. *People can readily understand. These are the kind of visuals that they are using now. Where's the site? Here. This is the declared area by the EPA. The development is going to look (like this). People can start to get an understanding. A web site can humanise a situation when it posts photos ...of independent experts to personalise them, so it's just not a name. People can put a face to it... and realise there is actually a person involved in that process.* One expert favours the use of an *interactive*, but recognises that *most consultants would provide information in a graphic form.*

Experts were asked about their use of imagery during the interviews. They consider that imagery is an *ideal* way to communicate. *If you can add visuals to education, then retention increases. It's...fundamental in communication in a non-technical person, something that people can relate to. It tells an immediate story. If you haven't got them, you've probably lost a lot of the audience. People...have varying perspectives...You need to be presenting in a way which...would engage most, if not all.*

Experts use a variety of imagery to engage people: *diagrams, photos, graphs, maps, a basic block diagram, a conceptual site model, a computer-generated 3-D image or interactives.* Images can represent *the declared area, environmental monitoring results or how the vapours can be transported.* They allow for clarity around complex situations. For example, *if you were in my office...I would say 'this site ...has got issues'. You would look at me quite blankly. If I draw a cross-section or a conceptual site model...you start scribbling away. That tends to be when you start getting people engaged.* Conceptual site models are among integrated image forms of the type that Priest (2015) recommends. Another image form that experts use is annotated photographs. Here is an example prepared for use during social engagement by experts, and provided here as Figure 7.7. below.



Figure 7.7. Annotated photograph. Representation of the configuration of a POPS waste destruction plant on the former Union Carbide site, Rhodes Peninsula, Sydney. Source. Image survey.

Figure 7.7. represents a remediation plant as a managed technical system. The photo is clear and the text is legible but if we apply the guidance provided by Priest (2015), additional textual information that explains the function of each part of the system would also be needed. Should additional text be included in this image, it would be too complex and the risk message lost in too much detail. To improve the quality of the message, this annotated photograph would comprise one part of a sequence of textual and non-textual language. This is how the image was used by the experts who designed it.

In another example, an expert describes how a photograph of a commonly occurring flower can be used as an analogy to describe the relationship between a hazard and the risk it poses. It is *an image of a dandelion dispersing its seeds, an analogy for what asbestos may do as a fibre coming off some lagging around the pipe. If you bump, it puffs into the air.*

Images can reduce unnecessary complexity. A situation can be *drawn in a non-technical way, simple, not too much in it, the information more digestible and easier to*

understand. You do not overwhelm the user with information. However, experts also point out that imagery can have the opposite effect if the message is simplified without considering the needs of the non-expert. Estrada and Davis (2015)'s recommendation regarding the need to identify "target audiences" (p.140) resonates here. For example, one expert explains that *it's not about dumbing down ... (It) is about selecting material that can become the focus of everyone's engagement, present(ed) in a way which will provide maximum access. You need to be careful not to oversimplify a complex issue.* Another expert considers that imagery can lead to disengagement: *You can have too much information. The more technical that you make it, the more suspicious those that don't understand it become. You slap a whole tome of figures on the table... If you see people looking at it with glazed eyes, you know that you've lost them.* In this last example, it is tables that are problematic and other experts agree. *Massive data in a table with multiple columns that you can hardly read is pretty ineffectual. Just a whole lot of data, not information.* On the other hand, tables can be useful *but only where they're colour coded.* Experts identify other visual forms that use colour, including *colour-coded areas, or colour tables that show high, medium, low or different coloured rings.* However, too much colour can create confusion: *You're hit with these circles, and half the time you keep looking at this... It doesn't help you to understand what's going on, other than there's a whole series of colours.*

Photos are a preferred form of visual language. *It's impossible to explain it without photos. They tell a thousand words, tend to relax people.* Experts see advantages in using new forms of digital imagery: *The visuals... are getting really useful, 3-D image. Interactives⁵¹... in a community setting would be a lot more effective... It's costly... but what's good... is that... it doesn't overwhelm you with information. You can go to the location you want without being misguided by... peripheral details. You can turn on, turn off layer... Not quite the Holy Grail, but as practitioners, (it is) where we want to go.*

Maps are another preferred form of visual language. *Most useful were maps.* However, experts consider that maps can be problematic as a form of risk communication. One

⁵¹ Interactive refers to visual representations that allow people to see a range of different aspects associated with the same situation. For example, a groundwater interactive might allow a person to create potential scenarios of groundwater migration based on changes in rainfall, or the presence of different types of contaminants; e.g. ones that are highly soluble, or ones that are not so soluble.

map is *stupid* because it placed the risky technology *in the middle*, which undermined its original purpose which was to locate *where we should deliver the brochures*. Another map makes a fundamental mistake, a *classic one*, by drawing a boundary around a risk and creating two sub-populations, one where the land contamination poses a risk, and the other where the risk is not considered significant. *You've got a map and you put a big...red line around it...The first thing that people do...they go to where that line is and...work out whether they live...on the line, inside or outside... Our science has got massive uncertainty about where we've plotted that line, but...a community would look at it and create a value judgement about whether they are going to die as a consequence of...drinking the water*. Here, the expert is referring to a particular situation within his recent professional experience, and below we show two maps that represent it. The map in Figure 7.8. was provided by an expert. It shows the NSW EPA's risk map (EPA., 2015), which was published in a daily newspaper (Newcastle Herald, 2015).

As an example of a visual representation of empirical uncertainty, the map indicates the location of monitoring points, and by this means, allows a boundary to be drawn around an area where there is groundwater contamination. Here, the expert is aiming to generate public understanding of the geographical extent of a risk.

The second map was part of a television broadcast about PFAS and is shown below in Figure 7.9. It represents a specific area from the same location, but the intent is different, aiming to convey the meaning of the geographically-bounded risk in terms of negative impacts on local property values.

Here we see how an expert's risk knowledge can be transformed to represent another form of risk. The design of the second image heightens the risk message by associating reduced property values with the involuntary risk experienced by people who live inside 'the red zone'.

An alignment with Kasperson et al. (1998)'s social amplification of risk framework (SARF) is apparent here. What began as a spatial representation of empirical risk, ended as a media-driven narrative around the ill-health of people living on "the Red Zone" (Washington, 2017). Priest (2015)'s perspective also resonates. She proposes that "map features... may influence the reactions of those who view them" (p.3). In this example of map features, the annotation of a map contributed to a heightened

awareness by residents about a risk, and sparked interest in a class action against the parties responsible for that risk (Newcastle Herald, 2015). Barnaud et al. (2013)'s way of thinking also aligns. They argue that a certain type of spatial representation "might lead (people) to think in terms of boundaries and segregated space, which could prevent them from thinking in terms of multifunctional space and from finding innovative and integrative solutions" (p.150). However, the proposal that a geographical frame around risk can prejudice creative thinking might not be applicable. This includes to the situation described above, where the placement of the 'red zone' clarified the geographical extent of the empirical risk for the people who were experiencing it. Whilst remediation might represent an "innovative and integrative" solution, these people will have other things to think about. For example, the cancer cluster down the road, the health problems of their pets and livestock, an inability to sell their property, or their current court case against the Australian Defence Department. As of mid-March 2020, an out-of-court settlement was reached between parties representing three communities exposed to PFAS contamination from by RAAF bases, including the Williamtown base (Kelly, 2020).

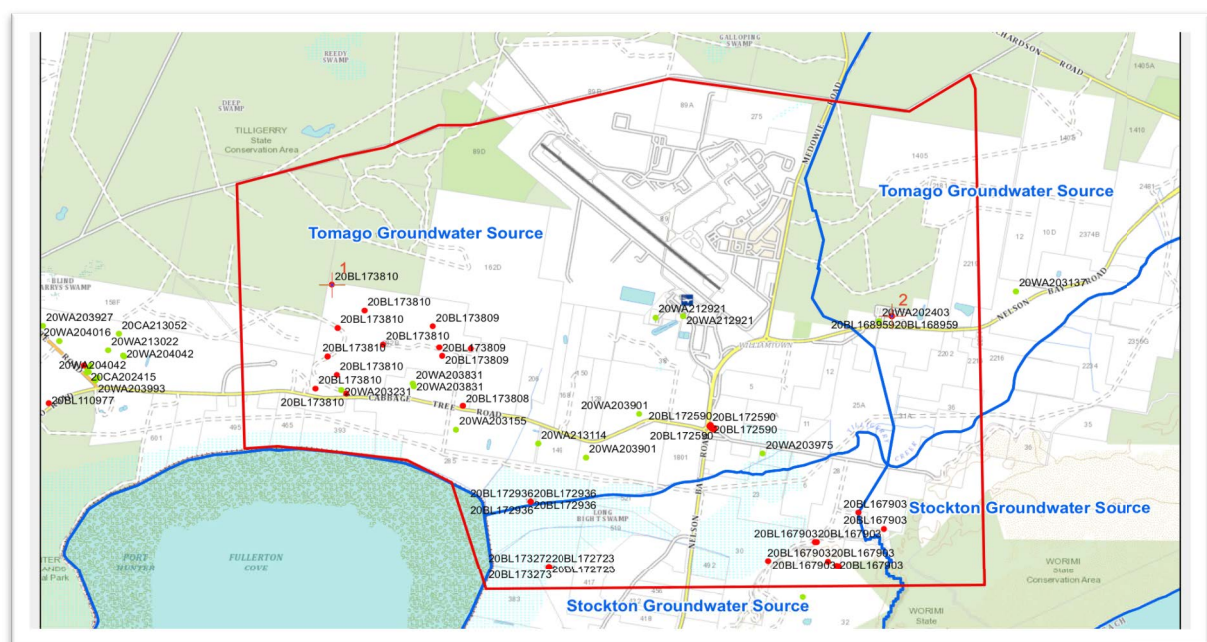


Figure 7.8. Risk mapping of PFAS contamination: Williamtown area, NSW. Source. EPA. (2015).



Figure 7.9. The risk of mapping PFAS contamination: Williamstown area, NSW. Source. A Current Affair (2017)

To this point, we have explored experts' use of visual language in the form of imagery. Now let's explore another type of visual language in the form of artefacts.

During interview, experts were asked if they use artefacts during social engagement. Some do, for example when they are small enough to bring to a social engagement process. *It has to be equipment that is relatively easily taken to these types of event.* Artefacts provide experts with the opportunity to show people that a hazardous substance can have various forms. For example, whilst *people think of HCB as a crystal...we had...examples of what it might look like.* There are *little jars full of various types of HCB* ⁵²...*it had gone all gelatinous, looked like a rubber octopus.* Artefacts include *samples of the hazardous material in suitable containers*, or samples of a substance used in their remediation, such as *vials of the iron that we used in that barrier.*⁵³

⁵² Refers to the POP, hexachlorobenzene.

⁵³ Refers to a remediation technology using reactive iron barriers. The contaminated groundwater passes through, and as a result of its interaction with the iron becomes less contaminated.

Artefacts small enough to use during social engagement include monitoring equipment which demonstrates *how we collect the samples*, or identifies *occupational health and hygiene aspects*. They include *sampling equipment, a PM10. and PM2.5 monitor, or a dust filter*. Experts use these artefacts to demonstrate the way in which contaminants in the environment are measured, which is something *the community might want to know* (because) *there's a concern about sampling*. When monitoring equipment is used in this way, it can show the geographical distribution of risks, and who is at risk of exposure. Under the conditions of their licence, experts are required to demonstrate compliance with exposure limits, and if they can show that they can comply, then *nobody could say that's not fair on me, because everyone was getting a bit of it, and it wasn't going to last forever*. Experts use a copy of an EPA licence as an artefact to show a *licence variation that allowed us to operate*.

Artefacts can provide a historical context of a remediation site. *We had some very old bottles (and) great historic illustrations...(to) get people interested... They can work really well, a very good way of communicating. They're reading about the history of these two interesting bottles that were found.*

Artefacts can be large objects such as remediation plant Experts are enthusiastic about their value since *if you can take people to a remediation site and show them, that's the best way of doing it. Everyone is quite engaged by that, and it's far better than showing a picture of it, or a thousand words.*

Experts are selective about when they would use artefacts. It might be *not too often. We might use them sometimes...probably not on a regular basis. I have seen them used, and usually I cringe. I've seen people put petrol into water, and then put an additive in and drink the water...plunging their hands into beakers of something...That...is snake oil salesman stuff. I'd steer right away from...eating something or smelling something*. Here, the expert is aware of the pitfalls of overplaying their hand, understanding that residents might detect insincerity.

To conclude, I find that:

Firstly, experts can identify a variety of image forms to communicate a risk message.

Secondly, experts can distinguish between useful and non-useful image forms and can account for this distinction.

Thirdly, experts can understand that a risk message can be transformed by other groups and represent different interests.

Fourthly, experts can understand that when they select imagery for use during risk communication, they need to keep the viewers' perceptions in mind.

Fifthly, experts can understand that artefacts are useful in risk communication when they align with its purpose, or can confound a risk message when they are used in an unsafe or irresponsible way.

7.4.2. Findings from the image survey.

Ten experts provided physical examples of imagery and links to web sites that contained imagery. One expert provided a digital image set. Selections of imagery from these sources was used to populate a survey which explored experts' image preferences.

I analysed images using the criteria and classifications identified by Barnaud et al. (2013) and Estrada and Davis (2015). Imagery that experts use includes maps, network graphics, graphs, Power Point presentations and photographs, as well as being included on web-sites. Imagery exists in simple, complex or integrated formats. Simple formats are represented by photographs, for example of a piece of equipment, whilst complex formats allow for more detail, including numeration, overlay, or the use of colour or icons. A simple format, for example, is a basic graphic representing a cross section of a contaminated environment. A complex format is a monitoring survey map with overlaying descriptive text which allows for a detailed representation of a risk situation. Another complex format uses a highly technical conceptual site model as the starting point in the creation of an image that is *more readily understood*. Complex formats allow for a traditional brochure to be re-created in different form, for example a sequential fold-out format. Another category is an integrated format that combines textual and visual language to create a specific sequence and context, for example in a PowerPoint presentation or on a website. Table 7.9. below summarises these findings.

When providing images, an expert makes a distinction between the content of risk communication and how it is delivered. He explains that *the nature of the presentation is as important as the content*, something that Hamilton et al. (2006) understand when

they propose that the “form of the hazard communication is just as important as the content and accuracy of the hazard assessment.’ (p. 8) Another expert selects an image on the basis of its functionality. Its purpose is *to show that it is a process that needs close technical management, it’s not something that just happens.*

To conclude, I find that:

Firstly, experts can identify a variety of image forms used in risk communication.

Secondly, experts can use a variety of platforms to deliver imagery.

To this point, we have considered experts’ knowledge and understanding about the quality of imagery used in risk communication.

Now let’s explore what non-experts consider important when imagery is used as part of risk communication.

Experts' image selection: 10/17 Classification by delivery platform, image type and content			
IDI	Delivery Platform	Image Type and Descriptor	Image Content
3	Hard copy industry newsletter	Complex: Photos of experts, laboratories and remediation sites with accompanying text	Experts and their remediation projects.
	During social engagement	Integrated: uses PowerPoint format	The auditing process associated with POPs sediment remediation
5	During social engagement	Complex: Enhanced map	A remediation site and surrounding urban environment
	As above	Simple: Photograph	A robot designed to handle POPs waste
	As above	Complex: Network Graphic:	HAZOP Flow Sheet showing a pollution control process.
6	During social engagement	Integrated: uses PowerPoint format	Thermal processes for POPs waste destruction
	As above	Simple: Digital photograph Set	A broad-acre POPs remediation project as it occurred over time.
7	Website	Integrated: uses PowerPoint format	A gasworks remediation project
8	Technical Report	Complex: Cross section graphic	A Conceptual Site Model of groundwater contamination.
	During social engagement	Complex: Cross section graphic:	As above
9	During social engagement	Complex: Network graphic:	As above
	As above	Complex: Graph	Ground water contamination
	Hard copy industry newsletter	Integrated: Photos with accompanying text, map of and environs, table indicating project status reports, Community Notice	Experts and their remediation projects
10	During social engagement	Integrated: uses PowerPoint format	Odour and risks of inhalation of different airs toxics
13	Presentation to an industry forum	Integrated: uses PowerPoint format	Brownfield redevelopment within a risks/benefit frame
15	Web site	Integrated: internet format.	Thermal processes for POPs waste destruction
	Hard copy industry brochure	Complex: Photo and text sequence	Remediation capacities
16	During social engagement	Complex: Network graphic.	The basic steps in risk assessment.
	As above	Complex: Cross section graphic:	Human health risk scenarios

Table 7.9. Experts' image selection: Classification by delivery platform, image type and image content.

7.4.3. Findings from the focus group.

In this section, I provide findings from the focus group of non-experts about the content of experts' visual language. Participants were asked to explore the content and meaning of a set of simple and complex images selected from the image survey or from an expert text. Seven images were used for focus group activities, but to keep the analysis manageable, I used six.

Participants were asked to describe what they noticed about each image, to relate what they felt or remembered, and indicate what messages the images conveyed to them. I used thick description to analyse the text, repeating the approach used in Section 7.2.4. to analyse Images 1-5

Two of the six were simple images, defined in Appendix 3.8. as images unembellished by any annotation. Four were complex images as understood by Estrada and Davis (2015), and defined in Appendix 3.8. as images which allow for the embellishment with, for example, words, insets, icons, legends or other symbols. Table 7.10. below provides details about them.

Six Images Expert content about assessment and remediation			
Number	Image name	Descriptor	Source
1	The masked expert	Simple image of an expert in full protective clothing standing by a stack	Image survey
2	Green earth	Simple image showing a stack, high-rise apartments and two piles of earth, one coloured, one natural	Image survey
3	A child crawling	Complex image showing a child crawling across a soil surface.	enHealth Council (2001)
4	Groundwater Treatment Plant	Complex image that represents a groundwater treatment plant.	Image survey
5	Site figure with boundaries	Complex image of a contamination source area and ground and surface water flow.	Image survey
6	Richmond RAAF Base and environs. Groundwater contours.	Complex image. Part of an ongoing management plan. Area map with complex overlay	Australian Government (2019b)

Table 7.10. Six images: Expert content about assessment and remediation.

Participants provided a quick annotation of each image. Let's first consider the two simple images. They are photographs.

Image 1, shown in Figure 7.10. below, is a photograph of an expert standing in front of a plant that destroys POPs. The emissions are steam containing levels of contaminants at, or below those set by the licence conditions. The emission standards have been calculated to be protective of worker and community health.



Figure 7.10. Selection from Image 1. “The Masked Expert”. Source: Image Survey

Participants annotate one feature of this simple image: a man in PPE.⁵⁴ They either understand or misinterpret the content of the image. On the one hand, content is accurately described as associated with *heavy industry* or *emissions*, and on the other hand, it is misinterpreted as *pollution* or *exposure*. Responses reflect a range of emotion. Participants are *put off* by the image, it is *intense*. There is *danger*, *machismo*, *lack of care*, it is *confronting...* *Suspicious*. One participant *focussed on the man first*.

⁵⁴ PPE is the acronym for ‘Personal Protective Equipment’

Image 2, shown in Figure 7.11. below is a photograph of a remediation site with an operating remediation plant, and adjacent residential apartments. Features include a green coloured mass in the foreground which is excavated contaminated soils covered with a dust suppressant product approved by the regulator. Other features are the brown coloured mass, which is clean soil that has been excavated as part of site works approved under licence, a stack with emissions, a scrubber, and occupied residential apartments.

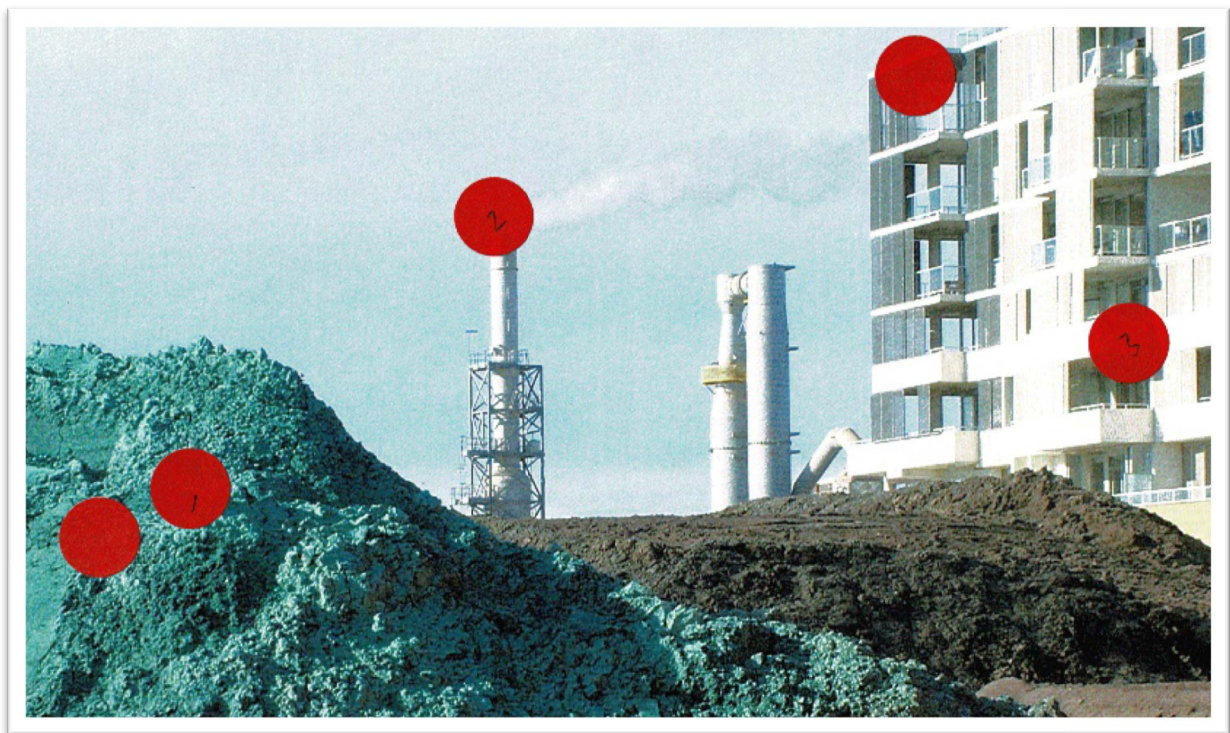


Figure 7.11. Selection from Image 2. “Green earth”. Source: Image Survey.

Participants annotate three features in this simple image: the soil, the stack and the apartments. They correctly identify the piles of earth as *earthworks*, *contaminated soil*, *industry* or *development* and misinterpreted them as *landfill*. Proximity between a hazard and place of residence is noticed, for example there is *closeness of housing*, or a *chimney close*. Responses suggest a range of emotion. Proximity of the *apartment buildings* to the *smokestack* sets off *alarm bells*, or a participant is *suspicious* (of the) *colour in the pile*. One participant makes a connection between the covered pile of earth and the stack. She *can’t stop looking at the green pile, then look at the smokestack*. Two responses reflect emotions. One is humorous, referring to the

piled green-covered earth as a *giant smurf poo*,⁵⁵ another suggests scepticism since the image might be the result of *photo shop*. The image raises *questions*. There are *many*.

Now we analyse the three complex images. The first is Image 3 and a selection from it is shown below in Figure 7.12. This image is a section of the front cover of a government report that provides guidance to risk assessors about how to calculate empirical risks associated with exposure to soil-borne contaminants. The image is of a child crawling across a soil surface, and the accompanying text is the title of the report.



Figure 7.12. Selection from Image 3. "A child crawling". Source: enHealth Council (2001).

Participants annotate all features: the crawling child, the earth and the title. One response identifies the earth as *layers of different sediment*, which is close to the intended representation of layers of earth which are contaminated, but the bulk of the responses reflect uncertainty about the risk message. A participant considers, for

⁵⁵ Smurfs are cartoon characters made popular in a childrens' television series.

example, that the *terminology needs context*. It *raises questions; exposure to what? Something in the soil?*

The second complex image is Image 4 and a selection from it is shown below in Figure 7.13. It is an expert's network diagram of a plant that remediates contaminated groundwater. It has multiple features, including a logo that identifies the company responsible for the plant operations represented in the image.

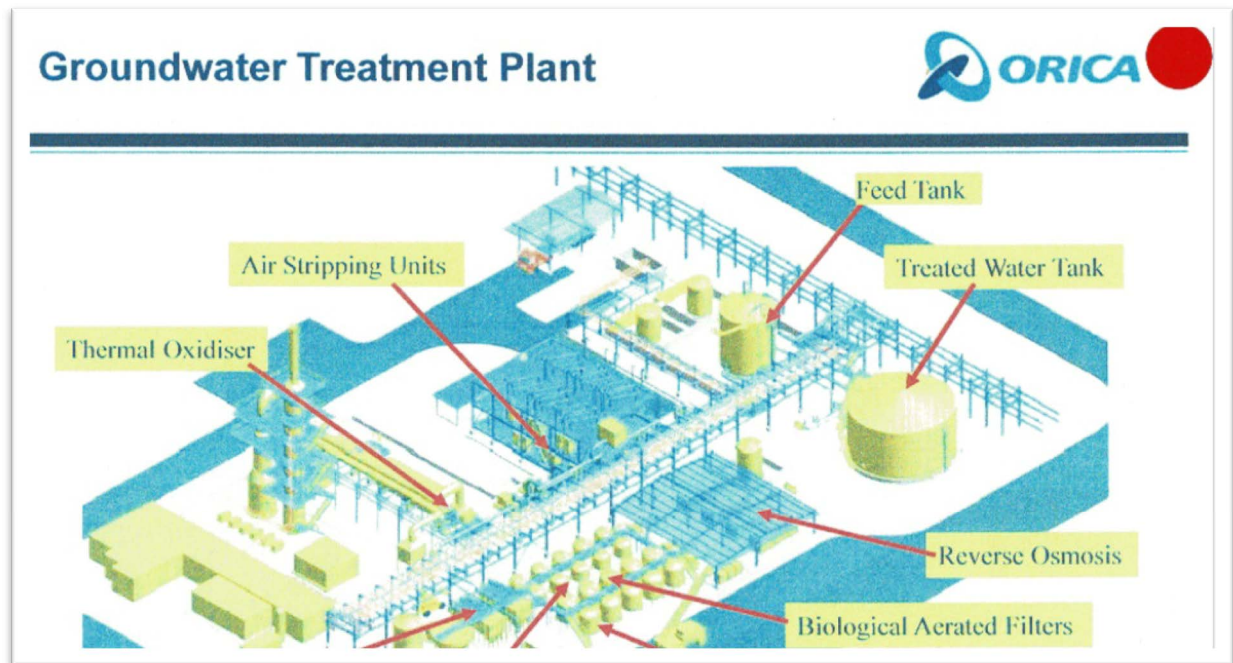


Figure 7.13. Selection from Image 4. Diagram of a groundwater treatment plant. Source: Image Survey.

Participants only annotate the company logo and one response reflects distrust of corporations in that *I'd feel inclined to google "Orica"*. A participant correctly identifies the content of the image as a *treatment plant schematic*, another considers the image is *useful in showing main points*, and another that it is *simplistic*. Uncertainty about the risk message is expressed: *What is it cleaning up?* On the other hand, a participant *learned something from this image*. One participant *feel(s) oriented, but still ... would like more info*. Another places the image within an ethical frame of environmental health , since *a lot of time and money (has been spent) to clean water that shouldn't have been contaminated in the first place*.

The third complex image is Image 5 and is shown in Figure 7.14 below. It comprises an annotated 3-D map of a contaminated area, and has multiple features, including a company logo, legend and geographical boundaries.

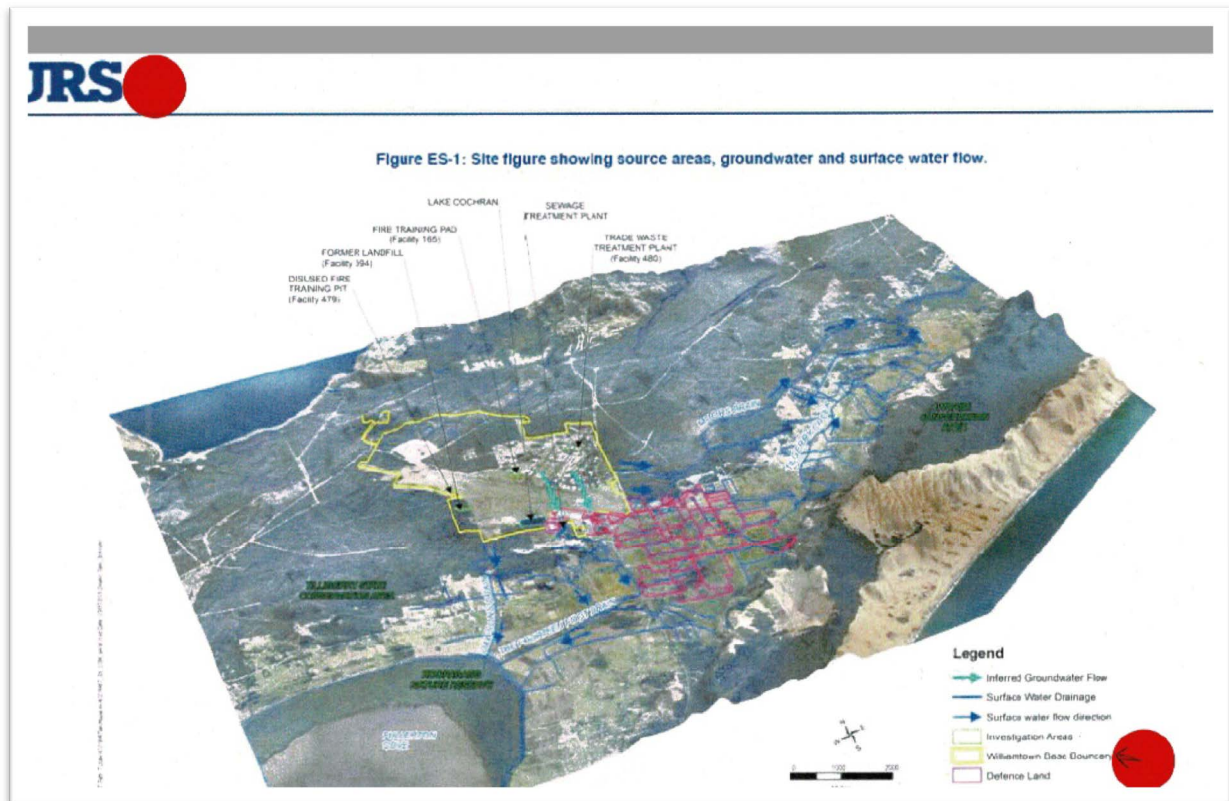


Figure 7.14. Selection from Image 5. “Site figure with boundaries”. From Image Survey.

Participants annotate two features: the company logo and the legend.

For one participant, the image contains *almost too much information to take in*, and another needs *more info*. One observes that *only Williamtown Base has been identified with markers*, and another that *the facts are incorrect*. These responses reflect uncertainty about the intent of risk message. Participants *consider* that Image 5 is of poor quality, for example, *map not clear enough*, *maps are never readable*, or *terrible resolution- can't read text*.

Let's go now to the analysis of data about the same imagery, this time using data generated from in-depth focus group discussion that took place over an hour. During this time, participants express the view that as individuals, they have their own ways of seeing. For example, one person describes herself as *not very literal*. So it was

interesting to see another interpretation of that. Another understands that people do interpret things differently.

Image 1. “The Masked Expert” (Figure 7.10).

This simple image of an expert elicits emotions. It is a great turn off, scary. I wouldn't like to live anywhere near this. I just felt put off by this image instantly, felt concerned and curious. I'm suspicious because of the equipment he's carrying. I just didn't like him. A lack of care. It just feels like "Humph!" A bit of machismo. His eyes were really intense. I felt concerned what was behind him. My automatic reaction is I need to know more about that situation, not just the picture. One participant expressed scepticism about the provenance of the image when he said from what our experience has been, it's totally staged, anybody can do this. It actually looks pretty photo-shopped to me. That's just me being the person I am.

In these interpretations, participants apply the experiential mode of thinking. (Slovic et al., 2004). At other times, they apply the analytical mode, and their perspectives are mixed. On the other hand, Image 1 prompts expressions around confidence or trust: For example, *I see a man in hazmat gear, he looks so smart, or if it's a trustworthy company, whatever is coming out of that stack is just steam.* On the other hand, Image 1 does not support the intended message of competence desired by the remediation company that created it. *It's got wires or supports underneath it. Why would it be pointing that way? So maybe it's not very safe up there.* In this image, the stack is oriented on what appears to be an angle, but it is only the way the photo is taken that creates this impression. This negative impression is shared by another participant who pits nature against technology when he states that *the blue sky suggests that it's pristine, and that this is an invasion of that.* Other responses indicate that the meaning of the message is unclear. For example, *What's in the smoke? That may just be steam. That might be a biscuit factory.*

The PPE worn by the expert prompts opposing views about its meaning. On the one hand, *I don't know if it's really doing the right job for him. He's got a mask over his eyes, so this must be some really toxic environment, there is something coming out of that stack and... it's going to be harmful.* One response associates the use of protective clothing directly with risk: *They're pumping the air full of toxic stuff because he's wearing PPE.* In contrast, another response associates PPE with a degree of

safety since *quite often, the people who are causing the contamination make the equipment as well, to protect you from the pollution. So he's fine, but what about the rest of the community around the area?* In this last response, we see that the participant is aware of the possibility of an unequal distribution of risk (Gregory et al., 2006), when the worker is protected but not the community, or when people are exposed to different levels of risk, depending on the location of their home (British Society for Ecological Medicine, 2008; Fleming et al., 1991) .

These responses suggest uncertainty as to the extent of risk that the image conveys. In the same way, participants *don't know what's being burnt, or whether this is harmful or not harmful to them. I don't know any background.* Another response was equivocal in that *I don't think I can assume that there's any kind of problem, other than there's a person in hazmat gear standing near a chimney stack. When I see something like that, I don't take any of it for anything.*

Image 2. “Green earth” (Figure 7.11).

This simple image of an urban remediation situation stimulates use of the experiential mode of thinking to interpret it's meaning. The image prompts an *immediate thought* (about) *the closeness of the buildings* whilst the visual experience of colour suggests confidence in experts when the green earth is described as *lovely green tealy-covered stuff* (referring to the colour 'teal') *that is supposed to cover the soil to stop it from blowing off and contaminating. It looks a bit like the colorant that they're using when they spray turf on the side of the road.* On the other hand, it is a *peculiar-coloured pile* or something *which you suspect is... toxic*, suggesting lack of confidence in experts, or their concealment of a risk situation. Another response is humorous: *Where is the giant Smurf that left that nugget?*

Participants also apply the analytical mode of thinking to Image 2 and describe the situation with some accuracy. For example, *there's obviously some major pollutant going on here.... some sort of processing going on, or obviously it's residential. I can see air conditioning units, or clothes in the balcony.* Responses associate the proximity of the technology to peoples' homes with risk to human health, and can give reasons why they think this way. For example, *the wind is blowing this stuff here, or all the dust ... will be blowing off this site ...into their homes. I think about the close proximity right next door to where people presumably live, or will live.*

A participant observes that only one pile of earth is covered with the green material, prompting a judgement about experts' competence to manage a contaminated site. *They haven't done a very good job because they haven't covered all the soil with the green stuff that's supposed to damp it down and stop it.* Here we see bottom-up processing of imagery in play as described by Severtson (2015).

The image prompts memories of an earlier risk situation where remediation was conducted simultaneously with urban development. *This is very reminiscent of what happened at Rhodes ... Some buildings were already built when remediation was still going ahead. It was a bit of a disaster.*

The meaning of Image 2 is difficult to discern. For example, *I had to have a couple of looks at the building to see whether it was part of the plant or not. What actually am I seeing? Is this closer here, is that further away? Just a flat picture. If somebody came to me, and that was the picture that they took, automatically I'd just go, "where's the aerial shot?" because you've got no perception of distance here. There's no depth in that photo.*

Responses include suggestions as to how to improve the meaning of the message. For example with a legend... *you could .. have the different-coloured soil identified, (indicate) what's coming out of the stack, the proximity of each of those things to each other. There's a lot of questions.. . that are raised, more so than answers given. I guess that's a good thing.*

Image 3. "A child crawling" (Figure 12).

This complex image evokes responses framed around risk to infant and child health. One female participant is professionally trained in *early childhood*, and she comments about *how vulnerable babies are, even in the womb, to all kinds of toxic chemicals.... Look at children walking on a carpet that's been sprayed to make it waterproof so that it's easier to keep clean. ...They get all the chemicals in them.*

Another female participant has a young family and considers that *we sometimes probably overlook children when we're thinking about the impacts of contamination. You forget that kids are right down there close to it, interacting with it, differently to us.* She draws on her memory to recall her son's exposure to another contaminant. *There was lead paint in our house when he was young. Anything he came in contact with*

would end up in his mouth, because he always had his thumb in it. Here, responses are to the image. Others are to the words. A participant notices that *this is the first (image with) words (that make a) connection to something toxic in the environment*. However, words do not help another to understand the meaning of Image 3. She does not really understand the words at all.

Responses indicate a lack of clarity as to the meaning to the image. For example, *it raises questions rather than provides any answers. Exposure to what? Something in the soil, maybe? Why? Where? Who? Are we just meant to have an emotional response or should we think more about it? I don't know. If there's a child crawling on the ground, that would be a scenario where it's toxic, but maybe if it's just something that you're walking across..., they're going to say, that's not where it's a pathway of exposure.*

One participant understands the image as *the start of some education material. I feel like it's not finished, and that it's the workings of communicating a likely scenario of how there might be a pathway of exposure of a toxic material*. Responses between participants are playful and humorous. One person says that the crawling child *might be playing in the sandpit for all we know*, another responds that a *sandpit doesn't ...have layers. There's bits and pieces*. Another quips *it does if you've got a cat*, and another provides a solution to a cat in the sandpit. *I put a towel on top!*

These examples demonstrate a mix of experiential and analytical modes of thinking about the meaning of a risk message. Some responses acknowledge the potential for an empirical risk, and process it applying an experiential mode of thinking which preferences child safety and adult responsibility, or uses humour to make some sense of the image. Other responses apply an analytical mode of thinking when they describe the content as *very scientific speak*, or pose a question about the risk to *the child.. on the ground...The question is 'what's there?'* To another participant, the terminology “exposure” suggests *that somebody is thinking in terms of how much of this stuff can we tolerate before we have to do something different*.

Image 4. Diagram of a groundwater treatment plant (Figure 7.14).

This complex image represents a groundwater treatment plant and is interpreted using the analytical mode of thinking. For example, *it's obviously a treatment plant, a mega-*

expensive bit of equipment. It shows the main parts of a groundwater treatment plant. The image prompts concern about the high cost of remediation, for example, it's a very complicated set up to treat ground water, the plant costs a fortune. It's very expensive to get that little bit of clean water. One participant refers to a remediation process that could be used to decontaminate the PFAS contaminated site at Richmond (N.S.W.). A reverse osmosis (plant) is going to cost gazillions to put in place, and who's going to pay for it? Responses indicate an interest in learning more about the creator of the image. I was like, "Hm... Who are these guys?" It raises some questions- "Who's Orica? " "What are they associated with?" ...It's just what they've provided about themselves?.

The design of Image 4 does not appeal to participants. *These sorts of diagrams don't mean an awful lot to me, or I need an expert to come and talk to me about it. One participant understands something about the intent of the message, but criticises its design. She does not know if it's designed to make you confident, and I think they're doing a great job, but it doesn't tell us where is all the rubbish going I can't see the link ups. So it doesn't really make me confident. It just makes me confused.* Here, a non-expert is signalling her need for better designed information, as recommended by Barnaud et al. (2013). Another participant finds that there is *too much in this diagram. It looks like overkill.* Another participant considers that the image is *a good layout of the structure of one of these works.* It allows a participant to feel *orientated... I've got my bearings. I felt a little bit satisfied that I'd actually learned something more than with the previous one.* Here the participant is comparing Image 4 with Image 3, which provides no textual information except a title.

Responses reflect an ethical frame about the need to avoid pollution. For example, *it probably shouldn't have been contaminated in the first place. So the precautionary approach would have saved- that saves millions of dollars just to get us to the clean water tank. If we were a bit more careful in the first place, we wouldn't have needed to do all that.*

Image 5. Site figure with boundaries" (Figure 7.14).

This complex image is an annotated map showing a contaminated site and the migration of contaminants beyond its boundaries. It is interpreted using the analytical mode of thinking and is useful to the viewer. *This is about pollution. It gives you a lot*

of details. It shows you where the ground water ..and surface water is coming from and what direction it's going to. It's got names and places. If I did live in this area, this could give me a fair bit of information. It shows where the Defense land is and where the Base is. It shows coastal habitat. ...There's a fair bit of groundwater and surface water flow in that area, and it would be deemed to be a sensitive site. Another positive response is because Image 5 is pictorial, so it kind of looks more like the real thing.

On the other hand, understanding the meaning of the image is beyond the ability of participants. For example, it is *ramped up in the terminology and language and 'the cycle' jargon.*⁵⁶ One participant *wouldn't even study (the map) closely because it means absolutely nothing. I wouldn't be able to make head nor tail of it. Unless you're very familiar with the area, ... you would struggle. When I was first presented it I felt overwhelmed, I felt like I needed to be taken on a tour ...I needed someone to explain it to me.*

Participants are not satisfied with the design and quality of the image. One recognises map legends and can see what it says, but ... *can't understand what the method's doing.* Another accepts that whilst *there's a lot of information, ...when you try to look at the map, it's not clear. My first reaction was that it's too much information... I don't really know what I'm looking at.*

One participant comments on the poor design of the image: *She can't even see where the investigation area is because it's green, and I can't make out where that is ... on the map. She observes that nearly all of the maps that are produced in the investigation that we've been involved in are very hard to see because they're not clear.* Notwithstanding these limitations, she *loves maps*, whereas another participant is *not a person who is good at reading maps It looks to me like the water is flowing up the hill ...and that goes against what I feel, so I think, what is it all about?... Trying to make it 3-dimensional is a big mistake.*

Another limitation is the location of arrows, since they are *too far away* from the area that they point to. This response conveys more than concern about its design. The location of the arrows is perceived as a ploy to disguise the risk: *It's like they're trying*

⁵⁶ Refers to the water cycle.

to tell you, don't worry it's not really getting contaminated by us. It's divide and conquer; confuse everybody. lots of little squares and jiggles. That fish thing ..it's a bunch of nonsense. I would question everything that was on that map, just because there's been a lot of diversionary tactics. Other responses also question the credibility of the information in the image. The area is known to one participant. *It is Williamtown. ...that's why there's no investigation area. Everything's fine. So cynical.* Another participant observes that *only within the Williamtown Base have things been identified with markers. Nothing else in this town has been identified. The title of this slide is about figures showing source areas, groundwater, and surface water flow, but it's only relating to that base, it's not giving the town any identification of how the water is interacting.* For one participant, the image reminds him about the limitations of maps that show contamination in his own local community of Richmond. *Details were wrong because local knowledge has been disregarded: They never spoke to anyone who knew anything about the water. They had the water flow completely backwards.*

Responses reflect concern about wider health issues associated with the inadequate regulation of hazardous substances. There is *the case with the 3M* ⁵⁷, or situations where *a lot of our issues with children today, particularly the ones with brain issues like Asperger's (are) related to chemical exposure. We're far too cavalier with the way we spray chemicals around everywhere, or our generation has done a lot of messing up of the planet. It's up to us to fix it up before this next generation of babies has to deal with it.* One participant considers this situation to be *the problem with Australia ... Everything is reactive. Nothing is proactive. Nobody wants to do anything in advance and make sure that it's good and clean. They just want to press ahead and make bucket loads of money.*

Overall, analysis of non-experts' interpretation of the meaning of the five images supports their classification around content and context, emotion, memory or experience, or reflected uncertainty as to the characteristic of the message. These classifications reflect Gregory et al. (2006)'s two modes of thinking, one analytical, the other experiential, and suggest that when simple or complex imagery is selected for

⁵⁷ 3M is a multinational company that manufactured adhesive coatings, including those applied to home products.

use in expert risk communication, the message that is intended is not necessarily what is communicated.

To conclude the analysis using thick description, I point to the guidance provided by Estrada and Davis (2015) who warn that when visual elements are used to communicate science, they might not be sufficiently integrated with the prose they accompany, thus limiting their power to connect with a non-expert audience. In this sense, it might not be true that a picture is worth a thousand words. As Estrada and Davis explain:” In order to construct better visual communications for science, professional communicators need to go beyond using images merely to ‘illustrate written material’ (p.142). In this sense, images have their own communicative power.

At this point, we move from thick description analysis to analysis using the Peircean semiotic triad (Tavory & Timmermans, 2014, p.24, Fig.1). We analyse how non-experts construct meanings around risk and distrust when they look at simple and complex images created by experts.

As explained in Chapter Three, Section 6.7, the semiotic triad explores the process of meaning-making. It begins when a person observes the ”object’, receives a signal from it, and in their mind, create an object-sign relationship. Then, in a process of meaning making, an “interpretant” emerges as the immediate translation of the object-sign. Immediately below, we see this process of meaning-making at work when participants provide a quick annotation of two simple images. Following this, we see a more nuanced process of meaning making when participants create multiple meanings about a complex image.

Firstly, we use the simple images 1 and 2 to reveal how participants arrive at an immediate translation of the sign-object, and demonstrate how they understand the relationship between risk and trust.

Example 1.1. The masked expert (Figure 7.10).

Image 1 is of an expert standing, arms folded, in front of a plant that destroys POPs. He is wearing PPE, including a face mask, and there are visible emissions from the stack depicted in the background. We allow that a non-expert identifies ‘the expert’ as the “object”, and the eyes of ‘the expert’ or the PPE he is wearing, as the “sign”. When

the non-expert connects this object with these signs, interpretants associated with lack of trust come into play.

When the sign is the eyes, it elicits interpretants suggestive of distrust. There is *intense* or *confronting* meaning, a meaning conveying the impression of *lack of care*, a meaning that the expert exhibits *machismo*, and a meaning that *put(s) off* the non-expert. When the “sign” is the PPE, it elicits conflicting interpretants about an existing risk. On the one hand, interpretants suggests immediate risk, in that the PPE might not be *doing the right job for him. He's got a mask over his eyes, so this must be some really toxic environment. There is something coming out of that stack and... it's going to be harmful, or they're pumping the air full of toxic stuff because he's wearing PPE. He has a respirator on. Suspicious.* On the other hand, an interpretant suggests protection from a risk, since *quite often, the people who are causing the contamination ...make the equipment as well, to protect you from the pollution.* A third interpretant suggests unequal distribution of a risk in that *he's fine, but what about the rest of the community around the area?*

Example 1.2. Green earth (Figure 7.11).

Image 2. is of a remediation site. Features include a green coloured mass and a brown coloured mass. In this example, the “object” is the green earth and the “sign” is the colour green. The object-sign relationship gives rise to conflicting interpretants about what the colour means. On the one hand, it is *this greenness* or *lovely green-tealy*, suggesting an acceptable risk, on the other hand it is *a peculiar-coloured* or a *suspicious colour*, suggesting a non-acceptable risk.

Figure 7.15 below, shows the application of Peirce’s semiotic method to illustrate the connection between the meanings of risk and distrust.

Table 7.11 below provides a summary of this semiotic analysis.

The Non-Experts' Construction of Meanings
After Peirce: Tavory and Timmerman (2014)
Figure 1, p.24

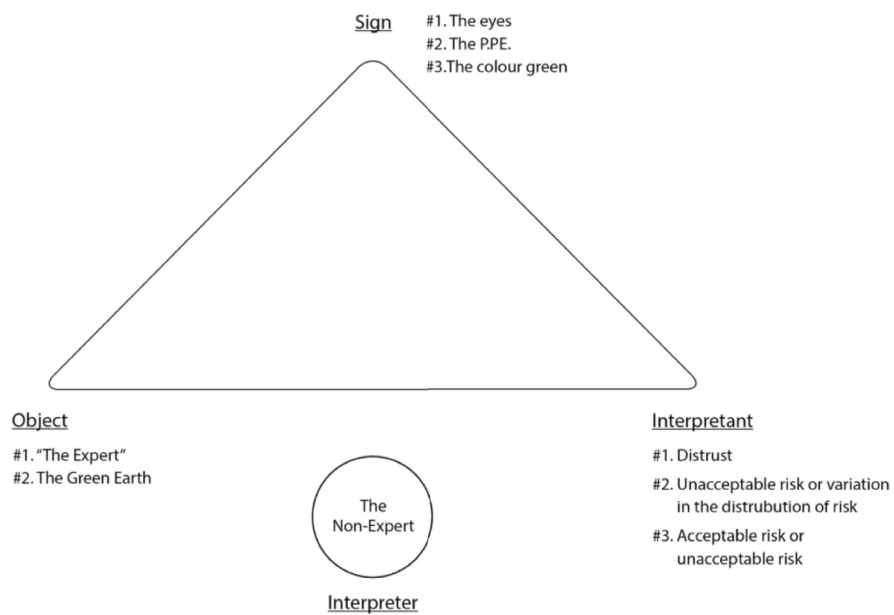


Figure 7.15. The construction of meaning of risk represented in two simple images

The construction of meaning using an object-sign-interpretant framework			
Object	Sign	Interpretants	Examples
Example 1.1 'The expert'	The eyes	distrust	<i>Machismo, intense, confronting, put off, lack of care.</i>
	The PPE	unacceptable risk	<i>I don't know if it's really doing the right job for him</i> <i>There is something coming out of that stack ... it's going to be harmful</i> <i>They're pumping the air full of toxic stuff because he's wearing PPE</i> <i>Suspicious</i>
		variation in the distribution of risk	<i>The equipment ... to protect you from the pollution.</i> <i>What about the rest of the community around the area?</i>
Example 1.2. The green earth	The colour green	acceptable risk	<i>This greenness, lovely green teal</i>
		unacceptable risk	<i>A peculiar-coloured, suspicious colour</i>

Table 7.11. Summary of a semiotic analysis of two simple images.

Now we analyse a complex image and show how participants interpret the meaning of map icons to construct multiple meanings about a risk.

The complex image is shown in Figure 7.16. below. It comprises an aerial photo overlain with icons and shaded areas that represent boundaries, locations, the direction of the flow of water, and contaminant concentrations. The image locates the groundwater contamination zone close to a river, with small towns, agricultural areas and patches of bushland visible. It was created by a private company contracted to the Australian Department of Defence as part of on-ongoing expert risk assessment processes about PFAS contamination at the RAAF Base Richmond (Australian Government, 2019b). This map image was not created specifically for the purposes of risk communication, but since it is posted on a publicly accessible web site, it can be seen by non-experts, including residents living in areas lying within the area represented. The Australian Department of Defence has publicly stated its commitment to sharing information (Australian Government, 2017), and because of this, can anticipate that non-experts will look at maps about risk and make their own

judgements about it. In this sense, Image 6 represents a *de facto type* of risk communication, since people who are potentially at risk from the contamination have access to web-based technical documents, and are encouraged by the site owners to use their web-based information resources..

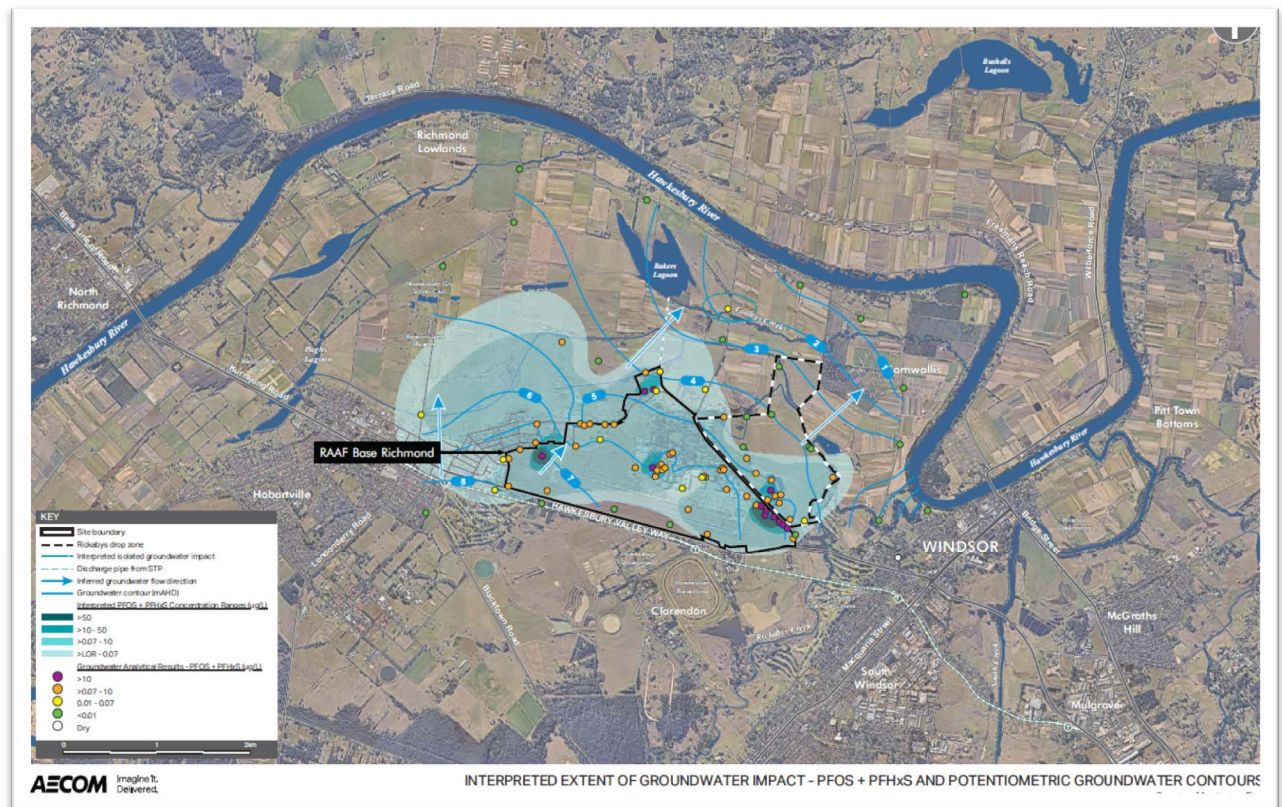


Figure 7.16. Image 6. Richmond RAAF Base & environs. Groundwater contours. Australian Government (2019b)

Semiotic analysis generated three examples of the construction of meaning. In Example 2.1, the “object” is a PFAS measurement icon (Groundwater analytical results), in Example 2.2, it is a PFAS direction icon (Inferred groundwater flow direction), and in Example 2.3, the “object” is any shaded area delineating different levels of PFAS pollution (Interpreted PFAS concentration ranges).

Example 2.1. The “object”: PFAS measurement icon. “Groundwater analytical results” (Figure 7.16).

The sign that this object elicits is its red colour, and the object-sign” relationship elicits interpretants associated with PFAS risk that could be unacceptable. It *scares people*, *is bad*, or a warning about risk that might occur in the future, in that it is *cautionary*.

Example 2.2. The “object”: PFAS direction icon (Inferred groundwater flow direction)

The sign that this object elicits is the direction of arrows. They indicate the transport of PFAS contamination from on-site to off-site locations. The object-sign relationship elicits interpretants associated with PFAS risk that could be acceptable. For example, it is *showing movement*, it is the *latest drainage program that they did*. It is *helpful*.

An individual participant's responses provide an example of multiple meaning making. In Peirce's schema, multiple meaning making allows for semiotic chains of objects that create a vector of meaning-making. Chains arise when the interpreter responds to the object-sign relationship sequentially. As Tavory and Timmermans (2014) explain, “the signs build on each other” so that “each semiotic triad is potentially connected to the next iteration of meaning-making.” (p.28- 29)

The participant responds to the direction of the arrows (the “sign”) sequentially. The first response is that *originally (she) really liked the arrows because it is showing movement* (first interpretant). At this point, one iteration in the process of multiple meaning-making has been completed. The second iteration allows that *maybe it's not showing me the extent of (flow) going into the river eventually* (second interpretant). In this example, the object-sign relationship has elicited two interpretants associated with PFAS risk: The first suggests confidence that the icon represents what it is meant to represent-the movement of PFAS contaminated groundwater away from the site. The second suggests that the icon might be concealing the full extent of the risk. This is indicated by use of the word ‘maybe’ which allows for possibility or probability, and the word ‘eventually’, which infers a distant future. It is in this sense that the extent of the risk inferred by the movement of groundwater is unclear to this participant.

Example 2.3. The object: Any shaded area delineating different levels of PFAS pollution (Interpreted PFAS concentration ranges).

Group responses provide another example of multiple meaning making. Interpretants emerge about variation in the intensity of the blue-coloured shading. At first, *shades of blue are confusing*, or of indeterminate direction, in that *when I looked at this map, originally I was like, is the blob going to come to me, or is it heading that way?* (first interpretant). Next, the *blue blob* is interpreted as showing *where the impact zone is*, or as indicating numerous impact zones, in that *that's why they've chosen different*

shades of blue (second interpretant). Finally the location of the *blue blob* is something that *raises other questions*. *What if we suddenly had a flood- this could go 'shoom.'* The sequence of interpretants that emerge from the “object”-“sign” relation suggest, firstly lack of confidence in expert content, then confidence about what it means, and finally, distrust about the capacity of experts to make predictions that communicate confidence in their knowledge forms.

In Examples 2.2 and 2.3 above, we see evidence of a continuing semiotic process about the meaning of the “object” which, as aligned with Tavory and Timmermans (2014)’s understanding, reflects a resistance to remain with any immediate signification, thereby providing a more nuanced understanding of risk.

Figure 7.17 below, shows the application of Peirce’s semiotic method to illustrate variation in the meaning of risk, and Table 7.12. below provides a summary of this semiotic analysis.

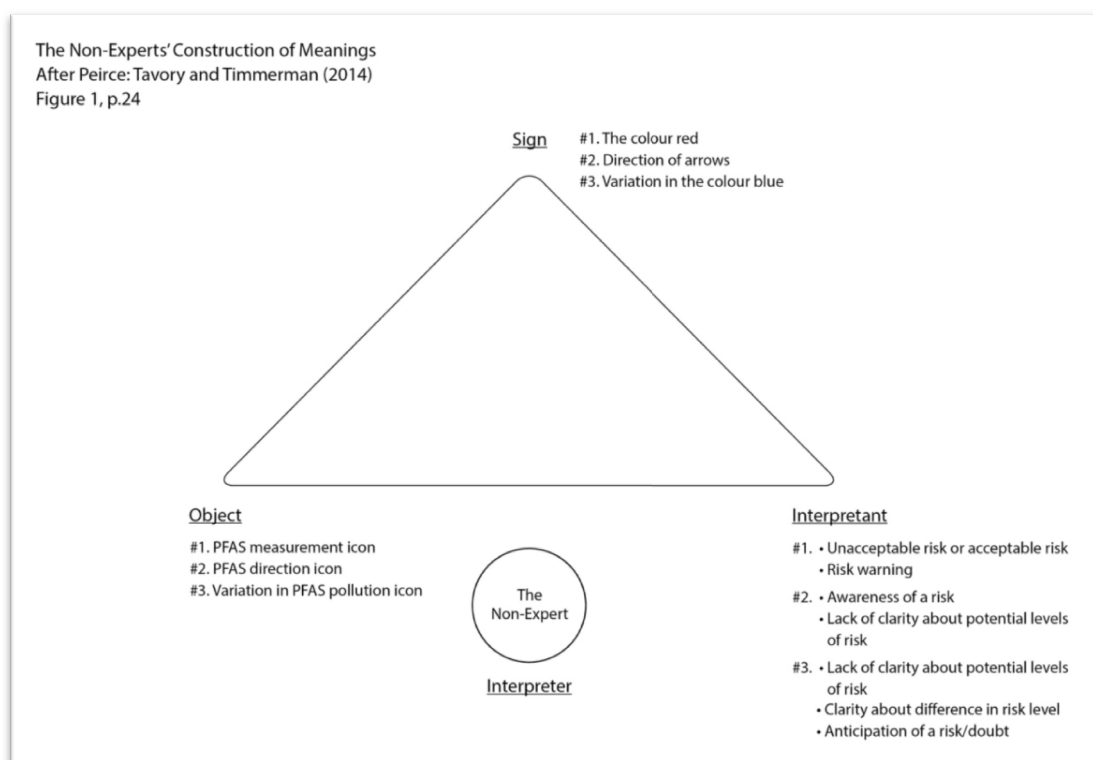


Figure 7.17. The construction of meaning of risk represented in a complex image.

The construction of meaning using an object-sign-interpretant framework			
Object	Sign	Interpretant	Examples
Example 3. Icon: ⁵⁸ Groundwater analytical results	Measurement of contaminants using the colour red.	A risk Protection from risk or acceptable risk. Unacceptable risk	<i>Hugely important</i> <i>Super important</i> <i>Problematic</i> <i>Red is bad</i> <i>Scares people</i> <i>Range of PFAS...red is the highest</i>
		A warning about a risk	<i>A cautionary colour</i> <i>Use red when you want to get someone's attention</i> <i>It's the first colour you see, as the human eye</i>
Example 4. Icon: Inferred groundwater flow direction	The direction of contamination as shown by arrows in an area	Awareness of a risk	<i>I originally really liked the arrows, because it is showing movement</i> <i>Helpful</i> <i>Those arrows... that would be the latest drainage program that they did.</i>
		Lack of clarity about potential levels of risk	<i>But maybe it's not showing me the extent of (flow) going into the river eventually .</i>
Example 5. Shaded areas:	Variation in the intensity of the blue-coloured shading in an area	Lack of clarity about potential levels of risk.	<i>Shades of blue are confusing</i> <i>When I looked at this map, originally I was like, is the blob going to come to me, or is it heading that way?</i> <i>(Will) water ...come up, this will be driven up to my property at some point. ?</i>
		Clarity about differences in risk levels	<i>This blue blob is where the impact zone is</i> <i>That's why they've chosen different shades of blue</i>
		Anticipation of a risk. Doubt	<i>It raises other questions.</i> <i>What if we suddenly had a flood- this could go 'shoom.'</i>

Table 7.12. Summary of a semiotic analysis of a complex image.

⁵⁸ All icons are referred to by the titles assigned to them on Image 6.

To conclude, I find that:

Firstly, non-experts can use both the analytical and the experiential mode of thinking, and allow for interplay between them.

Secondly, lack of context can confound or distort the intent of a risk message.

Thirdly, simple images are an unsuitable form of risk message because they lack context and stimulate unpredictable heuristic responses. Complex images are a suitable form of risk message when they are created using appropriate design principles.

Fourthly, maps are a suitable form of risk message when they are created using appropriate design principles. When design principles are absent, maps can confuse non-experts, or reinforce a cynical or distrustful attitude.

Fifthly, suitable design features include composition, selection and identification of, and relationships between, features, the use of icons, colour and shading.

Sixthly, non-experts use abduction when they assign different meanings to the same object.

Seventhly, experts need to apply design and content criteria to any image they post on digital media, or use during risk communication with non-experts.

7.5. Overall findings about the use of language in risk communication.

In this section, I make further findings about *the persona of the expert*. I introduce this construct in the preceding chapter when I find that experts can bridge communication gaps if they possess a sufficiently balanced *persona*. There, I identify four facets of *the persona of the expert*. They allow an expert to function as a professional, as an individual, as an emotional being and as a communicator. In this chapter, additional findings about the expert as a communicator have been made.

I find that experts can function as communicators:

Firstly, when they use both textual and non-textual language to construct a risk message.

Secondly, when they use integrated image forms to enhance the meaning of the risk message.

Thirdly, when they use textual language with the attributes of description, comparison, example, analogy, auxiliary verbs, the vernacular and narrative techniques.

Fourthly, when they select imagery and artefacts that align with the meaning of the risk message.

Like the other facets of their *persona*, experts' capacity to communicate is variable. On the one hand, they can distinguish between what is useful in risk communication and what is not, and can construct effective risk messages. On the other hand, they can lack confidence to undertake risk communication due to a lack of capacity to account for, and explain the relationship between empirical uncertainty and risk selection. In this latter sense, they are subject to the uncertainty paradox.

These findings assist to answer the first of the two research questions by providing evidence of expert content that can bridge gaps in knowledge and understanding between experts and non-experts who participate in social engagement processes about pollution remediation in Australia.

Let's go now to more findings that address the second research question.

Chapter 8. Analysis and findings: Social engagement.

This is the last of five findings chapters. I present findings about models, frameworks and current guidance about social engagement and risk communication, about non-experts' perspectives on social engagement, and about experts' understanding of its language.

8.1. Findings: The applicability of existing models, frameworks and guidance.

Chapter Two describes three overarching models of risk communication and two associated frameworks, and in this section, we make findings as to their applicability to contemporary social engagement where risk dialogues are in play.

Deficit models preference expert knowledge of empirical risk, dialogue models give priority to risk negotiation, and mental models confine themselves to characterising the relationship between empirical and perceived risk.

Table 8.1. below provides a summary of the three models.

I find that:

Firstly, deficit, dialogue and mental models are inadequate models of risk communication but nevertheless have useful features.

Secondly, useful features of deficit, dialogue and mental models include the accurate representation of empirical risk, the opportunity for social inclusion and improved transparency of risk knowledge, and the validation of competing knowledge forms.

Thirdly, limiting features of deficit, dialogue and mental models include lack of alignment with contemporary cultural preferences, failure to consider empirical risk or perceived risk, and the potential to create conflict in preference to cooperation.

Main Attributes of Three Theoretical Model of Risk Communication		
Model Name	Attributes	Assumptions and Limitations
Deficit Model	Focus on expert content delivery. Expert to non-expert knowledge flow. Addresses empirical risk. Legitimize experts' risk settings. Central role for the expert.	Assumes that educating the public about risk levels will increase trust and cooperation. Inadequate form of risk communication. Does not accommodate conflict between competing knowledge and value forms. Lack of capacity for conflict resolution.
Dialogue Model	Focus on social processes. Acknowledges power relations and individual agency. Two-way knowledge flow. Requires recognition of all knowledge forms. Prioritize values, inclusion and transparency. Harnesses self-interest.	Assumes causal link between dialogue and the generation of trust. Assumes that process promotes social learning. Can generate conflict and fail to deliver outcomes. Can allow participants to lose sight of the purpose of the process. Can over-emphasise the socio-political context of risk. Can neglect opportunity for social benefit.
Mental Model	Preferences consideration of mental states. Allows for tension between experiential (affective) mode of thinking and the analytic (cognitive) mode. Address the relationship between empirical and perceived risk. Validates people's attitudes and feelings about risk.	Assumes a central role for the individual experience of risk. Prioritize risk perception. Can fail to account for benefit. Can fail to account for a socio-political context of risk and risk selection. Can over-emphasise the importance of mental states.

Table 8.1. Main Attributes of Three Theoretical Models of Risk Communication

In Chapter Two, we also consider two other schemas around risk: the Social Amplification of Risk Framework (SARF), and the Trust, Confidence and Cooperation Model (TCCM). Here we make findings as to their limitations and usefulness.

Let's begin with SARF (Kasperson et al., 1998; Renn et al., 1992). This framework identifies sequential processes where multiple factors amplify the meaning of an empirical risk and bring forward impacts and consequences, most of these being negative. SARF was developed as a way to account for differing understanding about risks associated with events that are essentially out of the control of the people who, for whatever reason, are, or might be, affected by them. Think Love Canal, Bhopal or other uncontrolled risk events mentioned by Kasperson et al. (1998) and identified in Chapter Four. But then again, think the Rhodes Peninsula or the Homebush Olympic site in Sydney, where empirical risks were controlled via government-licensed remediation projects (Pym & Sydney Olympic Park Authority, 2001; Thiess Pty Ltd, 2013).

For this research, it is these latter projects that are of interest since they allow remediation experts to undertake activities that bring forward empirical risks with the specific purpose of delivering a benefit. The risk is around, for example, the removal of soil-borne contaminants, and the benefit is around the reduction of risks to health posed by exposure to them. Given this, rather than rejecting SARF outright, I provide another iteration that allows for a risky process as well as a risk event, and provide a role for experts. I do this by considering each classification of amplification, and the groups and individual responses, as shown in the SARF network diagram (see Figure 2.2).

When the expert is operationalised within SARF, s/he can counter what the framework refers to “sources of amplification” by undertaking “direct” and “indirect communication”. Experts can address what the framework refers to as “channels of information” by functioning as “professional information brokers” about empirical risk. They can involve themselves in what the framework refers to as “social stations of amplification” by drawing on their own experience, understanding the dynamics of “cultural and social groups”, and by performing roles in “information offices”. Within SARF, “information offices” are referred to as “PR” (public relations), but as we have found in this inquiry, experts eschew “PR” when defending the benefits that their industry brings to society. This does not mean the “PR” is not in play before and during remediation, including via experts. It just means that they usually try to avoid it. As one expert explained in an in-depth interview, *not a spinned approach. You’ve got to make it transparent.*

When the expert is operationalised within SARF, they can address what it calls “individual stations of amplification” by demonstrating that they are credible and trustworthy. As R. E. Kasperson (1986) explains, “individual stations of amplification” apply to individual roles (p.180), and in this regard, the expert’s role is to be aware that non-experts’ judgement about their credibility will affect how their risk message is judged. In other words, experts need to be aware that a non-expert’s mental filter allows them to say either ‘we don’t trust you, so we don’t trust your message’, or the converse. If non-experts believe that the expert’s risk message is credible, they will then decode the risk message and evaluate the extent of the risk using expert’s knowledge, albeit on their own terms.

Finally, experts can address what SARF refers to as “group and individual responses” by scrutinising reasons for their attitude to situations and willingly making changes to better reflect that situation, ensuring that their behavioural response to risk message is respectful as well as credible, and contributing to organisational responses that address the empirical risk in a safe and effective manner.

To sum up, if the risk message dominates, for example about a contamination situation, its meaning can be amplified by non-experts. If a benefit message dominates, for example about a remediation situation, an expert can counter the strength of the risk message by explaining the extent of an empirical risk, and by acknowledging the presence of a perceived (amplified) risk. In the modified SARF, we allow the possibility that the expert can be present throughout the message construction process, and by this means, communicate about benefit as well as risk. This then, is how and where the expert’s *persona* can be operationalized in SARF. The emphasis here is on can, since, as this inquiry finds, it is only when the expert has a sufficiently balanced *persona*, that they can explain and account for the difference between empirical and perceived risk (see 6.10).

As to the material world, SARF allows for ripple effects on affected individuals, community, industry, technology, and professional and stakeholder groups. These in turn, lead to negative impacts, including litigation, financial losses and loss of confidence in institutions. A modified SARF allows for ripple effects that lead to positive impacts in terms of benefits around increased land values, decreased risk and regulatory opportunities. Figure 8.1. below presents the modified SARF, with its’ attendant *persona of the expert*.

The *Persona of the Expert* Operationalised Within the Social Amplification of Risk Framework

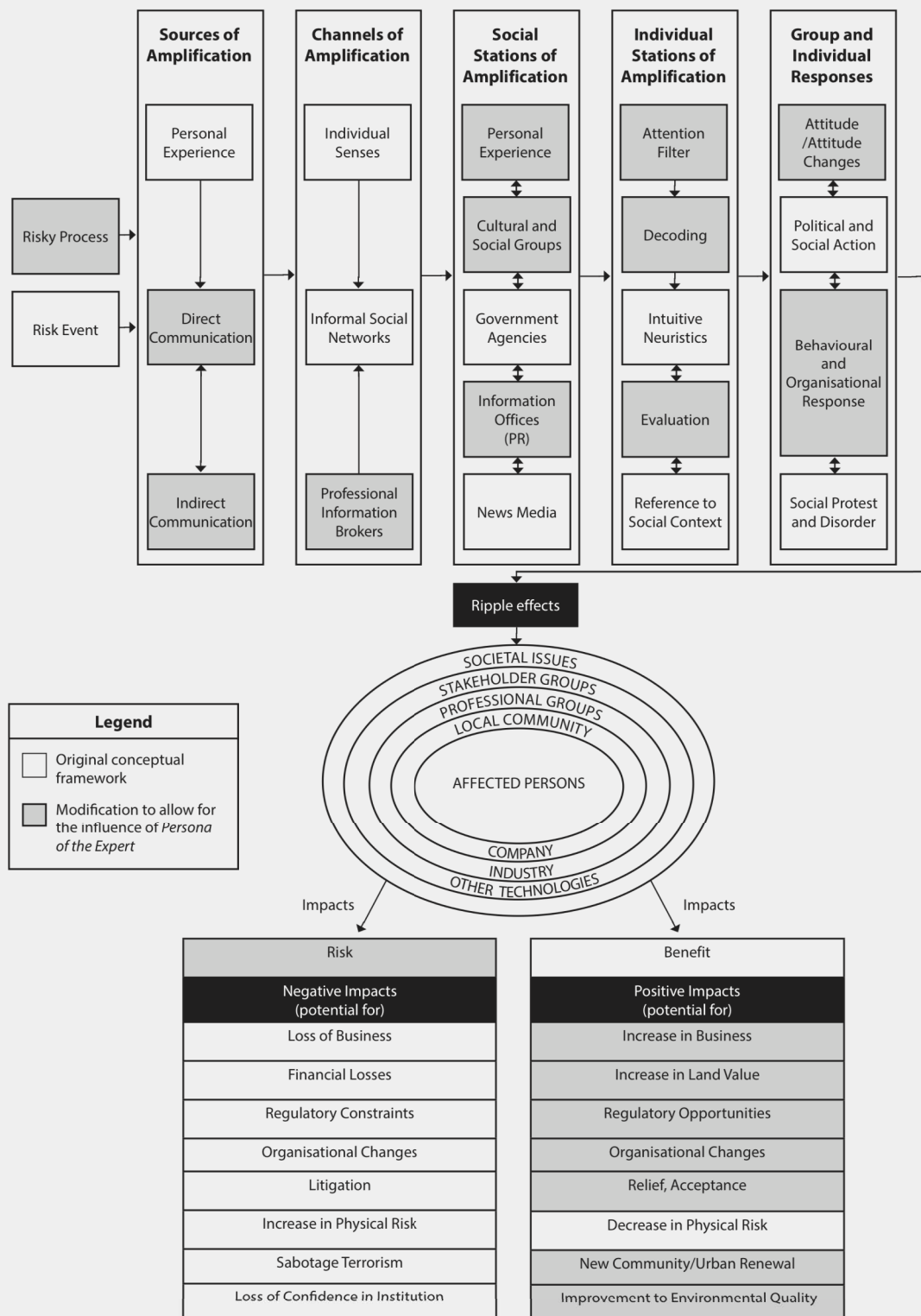


Figure 8.1. The persona of the expert operationalised within SARF.

Regarding the applicability of SARF, I find that:

Firstly, SARF has limited usefulness in situations where risks are deliberately taken with the aim of delivering a benefit.

Secondly, SARF can be more useful if it allows for a risky process that delivers a benefit as well as for a risk event that results in social and economic losses.

Let's now consider the applicability of the Trust, Confidence and Cooperation Model (TCCM) to contemporary social engagement.

TCCM represents the process of building cooperation between experts and non-experts, and makes a clear distinction between trust and confidence. It accounts for situations of high and low familiarity when an expert needs to be trusted by non-experts. In this framework trust is contingent on similarity of intentions or values, whilst confidence is contingent on judgements of past performance and evidence (Earle & Siegrist, 2006). What determines the balance between trust and confidence is familiarity. If a situation reflects high familiarity and low social uncertainty, then confidence plays the dominant role in cooperation. If a situation reflects low familiarity and high uncertainty, then trust is dominant (Earle et al., 2007 Figure 9.1. p. 194).

TCCM has a number of strengths. It identifies the critical role of confidence and performance-based information in the building of trust, and focusses on cooperation as the desired outcome. In this way, trust and confidence function as tools in a risk dialogue. They are not ends in themselves, rather they are the means to an end.

The limitation of TCCM is the failure to position distrust as a key driver of cooperation, positioning distrust as the opposite of trust, and a mental state that needs to be minimised. Earle and Siegrist (2006 p. 399) speak of "the absence of social trust" and only mention distrust once, in connection with the inability of experts to claim "reliable performance", and because of this, be distrusted. Their framework disallows any potential for situations when both trust and confidence are in play. I prefer Luhmann's argument. It requires that trust and distrust be considered as functionally distinct, and competing for dominance during a risk dialogue. As he explains it: "Distrust is (a precondition) for every sort of commitment to the future" (p. 20). TCCM does not allow for trust and distrust to co-exist in situations of either low or high familiarity. It assigns no place for any distrust that may arise when a future situation is being considered,

rather it preferences confidence. By dint of insistence on the importance of value similarity and reliance on trust and confidence, TCCM fails to accommodate situations where non-experts distrust what experts tell them might or could happen in the future. They could reject a future that is unfamiliar, or might try to make sure it never happens.

Regarding the applicability of TCCM, I find that:

Firstly, TCCM has limited usefulness because it fails to account for distrust when risk situations are either familiar or unfamiliar.

Secondly, TCCM can be more useful if it allows a constructive role for distrust during social engagement about a risk.

In Figure 8. 2 below, I provide a new version of the TCCM which draws on Luhmann's "binary *schematization* (and) allows for the co-existence of trust and distrust" (p.86).

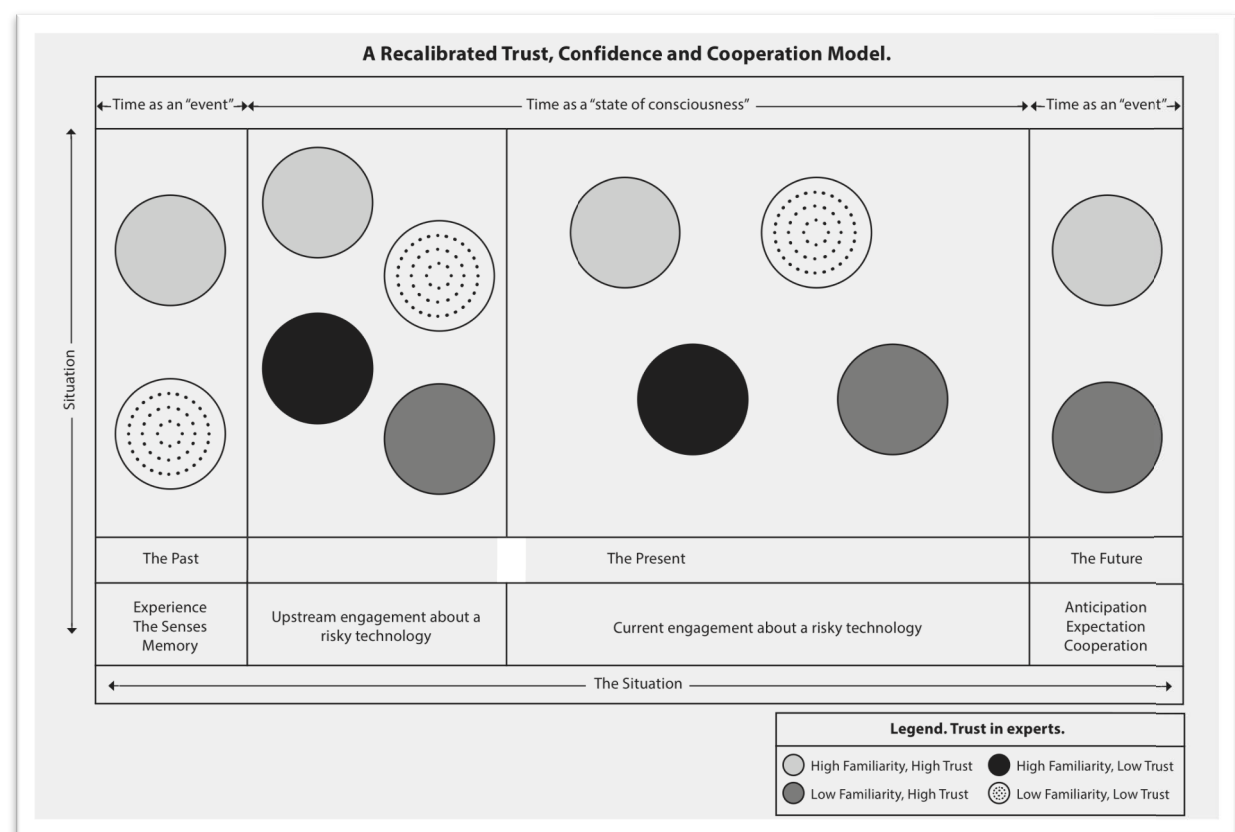


Figure 8.2. A Recalibrated Trust, Confidence and Cooperation Model.

To this point, we have made findings about the limitations of models and frameworks described in the social science literature. Now we make findings about current guidance provided by Australian governments and associated organisations.

In Australia, recent and current guidance on social engagement and risk communication focus predominantly on process at the expense of content. For example, see Western Australian Department of Environment and Conservation (2006), National Environment Protection Council (2013), South Australian Environment Protection Authority (2015), Australian Government (2017), Australian Department of Defence (2019), CRC CARE (2019a) and CRC CARE (2019b) .

Regarding the professional social engagement industry, their specialists also pay attention to processes and emphasise the importance of inclusivity and dialogue, with little attention paid to issues around independence and content credibility. (Butteriss, undated circa 2010; International Association for Public Participation, 2013; Twyford, 2014).

Both government and industry commonly defer to the approach offered by (Sandman, 2012). His well-used formula 'risk equals hazard plus outrage' is positioned as a way to address public reaction to an empirical risk. It plays to the lowest common denominators of dread, fear and anxiety, and in the age of social media, has potential to amplify risk perception out of all proportion to the empirical risk. This may not only be counter-productive in terms of outcomes, but also costly in terms of time and effort.

So is Sandman (2012)'s approach out-of-date? Not in situations where the pollution situation is so risky and its regulation so poor that the only rational response is outrage. In this regard, there are many situations now in play around PFAS contamination in the U.S.A., for example Staff. (2018), and in Australia, for example, Kelly (2020).

PFAS contamination is something that does outrage people, and it is little wonder that Sandman's schema remains well in play. However, if, as in this inquiry, one is looking at risk situations that exist to provide a benefit, then Sandman's approach has limited benefit. Why would anyone be outraged about a benefit that accrues directly to themselves or the community? It doesn't always make sense to use Sandman's schema, but this does not curtail its popularity. Besides, as our consolidated findings

show, not all experts can frame remediation risks in terms of benefit when they communicate with non-experts.

Formal guidance about community consultation and risk communication is provided through a National Environment Protection Measure, or NEPM. (National Environment Protection Council, 2013). The NEPM describes what is needed to achieve effective social engagement, and “is intended to be used as a tool for effective consultation by consultants and regulators’ (p.2). In this way, the NEPM is effectively a “how-to” manual for experts about managing the community’s expectations and avoiding risk amplification by control of content and content delivery. A major limitation is failure to mention values, except in relation to property values. The variety of approaches provided in the NEPM suggests a hybrid model. It draws on the mental model in terms of accepting the legitimacy of risk perception, and acknowledging uncertainty and involuntary risk(p.4). Being “honest, open and frank” and communicating “with compassion, kindness and respect” is emphasised (p.10). The dialogue model is also in play in terms of acceptance of the legitimacy of public involvement, and the need for “two-way community consultation, that provides for community participation in decision-making...contributing to....increased ownership of negotiated decision processes.”(p.4) The need to allow sufficient time and for flexibility is also acknowledged (p.9). Whilst the NEPM ticks a lot of boxes around contemporary preferences for social engagement, as with other formal guidance documents, it defers to Sandman’s formula about managing community outrage, and takes consideration of the mental processing of risk information no further.

Guidelines on stakeholder engagement are provided by CRC CARE (2019a), and as with the NEPM (National Environment Protection Council, 2013), these guidelines suggest a hybrid model, this time reflecting all three models of social engagement. Regarding the dialogue model, it emphasises the need for early engagement, for accepting the legitimacy of community participation and stressing the importance of dialogue and mutual understanding. The mental model is reflected in the following phrase from the NEPM about engaging the community: “Trust, credibility, competence, fairness and empathy can be of as equal or greater importance to the community as facts and figures.” (p.42) These guideline acknowledge that some people will not be satisfied and that experts cannot expect to be trusted (p.43) . They also allow that experts can demonstrate honesty and transparency by allowing

“emotions (excluding anger) to show”(p.29). Experts need to be “honest, frank and open (p. 43), and “talk about positives as well as negatives...such as relief, healthier local environment, renewed public space and improved environmental conditions (p.43).

Regarding the presence of the deficit model, the guideline goes further than other guidance documents by including substantial reference to the use of imagery to explain technical aspects of remediation (p.28). Also new is mention of the need to acknowledge data gaps in information, “If clear scientific and technical information does not exist, say so” (p.19). Regarding key issues around the credibility of knowledge forms, the guidelines recommend a third party independent chair be in place when complex sites are the subject of social engagement, and that decision-makers “demonstrate commitment to accountability and transparency” (p.10). Just how they could do that is not addressed.

Regarding the applicability of current Australian guidance, I find that:

Firstly, Australian guidance reflects a hybrid model of social engagement and risk communication.

Secondly, Australian guidance has much to offer, and is not without limitations.

Now let’s go and explore what non-experts think about the process of social engagement

8.2. Findings from a focus group: Non-experts’ assessment of social engagement processes.

In this section, I provide findings from a focus group that explored non-experts’ assessment of social engagement processes created and managed by government and industry. By way of reminder, in the previous chapter, we made findings about non-experts’ responses to expert content as expressed during risk communication. (See 7.2.4 and 7.4.3.). Here, we make findings about non-experts’ responses to expert-led process as it plays out during social engagement. Appendix 3.2. provides details about the composition of the focus group.

During a one-hour session (Activity 3), focus group participants explored two texts, one provided by industry, the other by government. As with Activity 2, (see Chapter Seven), Activity 3 required participants to discuss and respond to a document set, this time comprising industry and government explanations about how they engage with residents who live near a PFAS-contaminated site. Participants were encouraged to describe their own experience of social engagement, or of others whom they might know.

There are two texts. Text 4 is a two-page document and Text 5 is a text-focussed diagram. As with a similar diagram used in Activity 2, Text 5 was selected on the grounds that its written content provided the meaning of the message, whilst the images were icons that conveyed no additional meaning about it. Table 8.2 below identifies and describes the texts.

Two texts Expert content about community consultation and social engagement.			
Number	Image name	Descriptor	Source
Text 4	AECOM Community Engagement	Provides guidance about the conduct of community engagement	AECOM and Grey (2019).
Text 5	Network graphic: Stakeholder and Community Engagement.	Representation of options for stakeholder and community engagement	Australian Government (2019a)

Table 8.2. Two texts: Expert content about community consultation and social engagement.

Text 4 is a web-based text called “Community Engagement and the writer’s by-line is simply “Ellen Grey”. Figure 8.3 below provides a selection from the web site, including the Text 4 sub-heading, “Managing Expectations at PFAS Community Information Sessions”.

Text 5 is a network graphic and as shown in Figure 8.4. below, it contains text and icons representing different ways to engage the community.

During Activity 3, there was free-flowing dialogue between participants about the content of the texts, and a sharing of experiences about community engagement around contamination risks.

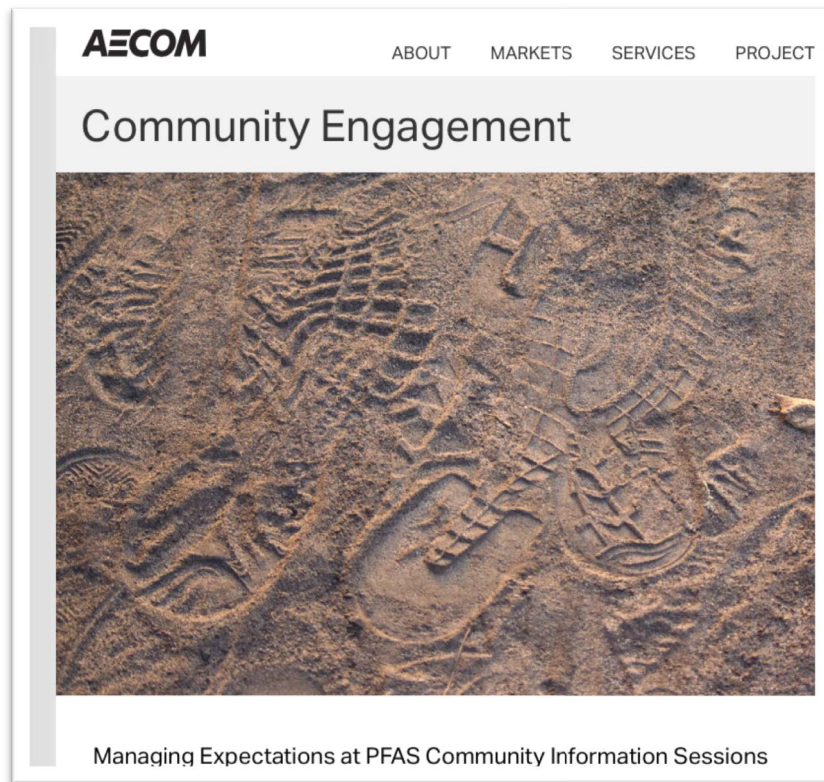


Figure 8.3. Text 4: Selection from an industry website about community engagement. AECOM and Grey (2019).

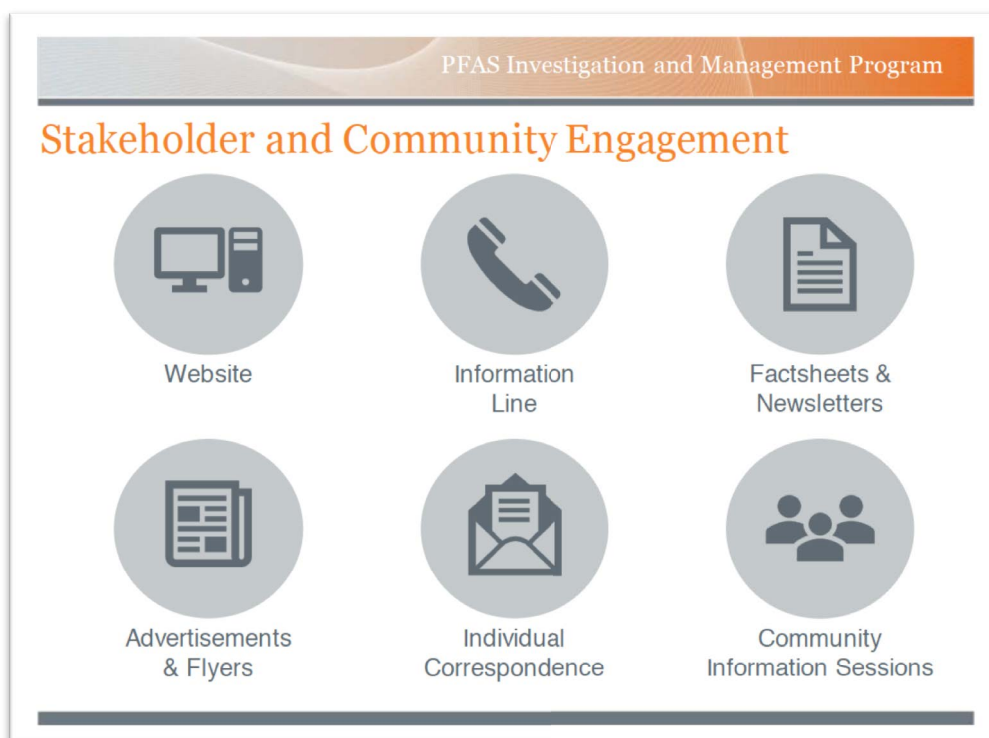


Figure 8.4. Text 5. Network graphic representing aspects of stakeholder and community engagement. Australian Government (2019a)

8.2.1. Non experts' assessment of methods of social engagement and their lived experience of it.

Participants understand the content of Text 4. It contained *all the different ways to connect with the community. There's all the information, fliers, individual facts.* They have mixed opinions about the relevance of its proscriptions. They can be useful, for example, *you have to inform in a variety of ways.* One way that is missing is local government, since it has knowledge about site contamination, including on their own land and in local waterways. *That's an information source that's missing.* Text 4. should contain *another bubble*, meaning that another icon should be added to it. Lack of inclusion of new forms of communication is noted, and a participant considers that *social media is a really strong way to get a message out.*

A participant refers to that part of the text which specifies an obligation to provide information that has been requested. *It says it's important to make it clear that if questions cannot be answered on the spot, the issue will be further investigated and a response provided directly to the individual or community.*

The lived experience of community engagement around PFAS contamination is, for some participants, very different to the methods of engagement depicted in Text 4. For example, *if they don't follow through, or they don't come to those meetings with any kind of solution, this is just the token, 'reaching out'.* Participants have not experienced sensitivity towards them during consultation, including about the economic costs to *small businesses. We have no money. So it's not just health that we're concerned about....Every day that (the contaminated site) is leaking water it's costing me money. Money (is) not leaking out of their pocket..* Lack of sensitivity is reflected in a lack of dialogue between those who are responsible for the risk, *the perpetrator, the instigator*, and those who are involuntarily taking the risk, *the community.* Sometimes, the risk owners *hide, shut down. The presenters are on the defensive. It's (an) adversarial kind of situation...The participants are on the ready to attack...It is questionable what you can really get out of that.*

Participants refer to Community Walk-In sessions ⁵⁹, and consider that *they haven't got a direction*. People are dealt with on an individual basis so *nobody hears your question, everybody's getting their questions asked all around the room, and you don't hear everybody else's questions. That ...is wrong*.

Questions go unanswered in the Walk-In sessions. For example: *I had (written) my questions down. I gave them the sheet at the end, and I have not had a response. We were shut down at every turn*. One participant went public with her unanswered questions, airing her concerns on a news program. *After the story ran on Channel Nine News, (we thought) that we would be inundated. No one contacted us. Nobody from Defence, no one from DPI,⁶⁰ no one from EPA, then (we) went on the radio, and still no one has contacted us*.

When the risk owners do respond to community concern, they can make assurances and at the same time, admit to lack of evidence, or decline to answer questions. *When the Defence, and New South Wales Health, and the EPA have all come together to speak to us, they're not across the whole situation themselves*. One participant experienced this when she acted as Owens (2000)'s "active citizen" (p 1146), explaining that *I had two questions when we first found out about it. Was the water safe for the cattle? Is (their meat) safe to eat? Nobody could answer my questions. I spoke to EPA, DPI, MLA,⁶¹ to N.S.W Health. (They said) 'you'll have to speak to Health', 'that's not our area', 'we can't comment on a specific site'. (The EPA) protocol that they push out to you is to call your local council first, before you call the EPA hotline*. Another participant experienced lack of accountability at a Community Walk-In: *There is no one group or body that is across it. You just go down there to New South Wales Health for this answer. And you move around the room*. In the same way, when a participant *rings the Department of Defence's hotline and (asks) them a question, (they answer) 'that's EPA', 'that's Health', 'that's DPI'*. In our experience, *there wasn't any one specific point (of contact)*. Here we have examples of what Beck (1992) referred to as organised irresponsibility. Plant et al. (2012) refer to this when

⁵⁹ Refers to Community Walk-In Sessions organised by the Australian Department of Defence as part of community consultation about PFAS contamination at the RAAF Base Richmond, N.S.W.

⁶⁰ Department of Primary Industry

⁶¹ Meat and Livestock Authority

they make findings about institutional failure to address ecological risks. In their study, it was pesticide contamination of the Hawkesbury River, N.S.W. that was the focus, but the message from this research aligns with participants' experience of government regulation of PFAS. It's hardly a new situation. Smith (1991) represented organised irresponsibility in a detailed network graphic about pesticide regulation as it existed three decades ago (pp.40-41).

Participants identify shortcomings of the social engagement process about contamination at their local area (Richmond). For example, *what's missing is connecting to the community, understand(ing) the mentality of this community. They don't appreciate that we want to eat the local produce.* Here we see a values frame around the contamination issue. It aligns with Renn (2006)'s proposal that "when judging whether or not something needs to be done about (a risk)", values can be applied. (p.12)

Participants consider that the owners of contaminated site are out of their depth. *Defence is probably not really good at community consultation. It's not their core business... it's not in their DNA, almost beyond thinking that they need to consult with the community. They control their truth in the case of an emergency, or need to go to war. I don't think that they're bad- minded about it. They mean well, but their whole psyche is wrong. They're totally flops.* One participant extends the idea and suggest(s) *that there's a deeper cultural malaise in terms of the organization,* and another suggests the same, in that the Department of Defence is *quite removed from the real world.* One participant brings another perspective to bear when suggesting that *the people who are holding these (meetings are) scared of people.*

Participants reject the claim that there is community consultation by those with responsibility for the contamination at the RAAF Base Richmond, and express lack of confidence in their motivation for engagement. For example, *They've done things like trying not to inform the community while informing them, so that they don't get a response. (Then) they can say, 'well, nobody's interested anyway', which is what they've said to (us). (They say) 'you're the only ones that are worried.'* There (is a) *distinct, definite strategy of how they handle this. ...to dismiss that there's a problem at the start.* The community engagement process *sounds quite adversarial and dismissive of your concerns. It seems like, 'It's okay, don't worry.'*

A participant compares the meaning of the message in Text 5 with her experience. She understands the message as saying *'we're doing all the right things', but in our personal experience ... we couldn't find the information. At the last meeting ...they doubled down on what they said in the second meeting. They said, 'No. There's not a problem with it, you still have a saleable product, but we haven't done any research on it'*. Again, we hear echoes of situations described by Beck (1992) and it is worth repeating his exact words, written over 30 years ago.⁶²

“What becomes clear in risk discussions are the fissures and gaps between scientific and social rationality in dealing with the hazardous potential of civilization. The two sides talk past each other. Social movements raise questions that are not answered by the risk technicians at all, and the technicians answer questions which miss the point of what was really asked and what feeds public anxiety” Beck (1992, p.30).

Participants have experience with all forms of information delivery identified in Text 5 and their experience has not been without problems. Sometimes problems are addressed, for example, regarding web-based information. At first *the website was very difficult to navigate. They have actually fixed it up a little bit*. Similarly, with Fact Sheets, *when I first got them were so technical... They have improved a little bit*. When a participant uses an information line, she gets *an answering machine. I've never once actually spoke to a person ...but they do get back to you*. Hard copy flyers are sometimes used, but delivery can be sporadic and lack consistency. *Flyers... in my letter box* provide information but there is no consistent delivery. *Only recently have I got the information about information sessions coming into my letter box*. Emails can be used for *individual correspondence* (but it) *has been negligible for me even though my eggs are contaminated...They have been contacting me by email now*.

Regarding newspaper advertisements, opinion about their quality varies. On the one hand, *to give them credit, the Department of Defence did advertise in the newspaper*, and on the other, advertisements are neither well-placed or properly designed. *They really need to engage a designer or an advertising person to guide them. It's no good tucking it in on the bottom page down under the advertisements in the back of the*

⁶² “Risk Society” was originally published in German in 1986.

newspaper. A related issue is *that many community members do not read the newspaper, either too busy or whatever*. Newspapers are not seen as an effective way to communicate because *the newspaper as a form of media is in a diminishing phase at this time*. *That Fairfax newspaper closed just recently*. Another communication format is digital media, but participants prefer a more personal approach since *we're all directly across the road from.... the main pathway (of the contaminants)*. *I shouldn't have had to read about it on Facebook. That was a problem for us. We had to read about it on Facebook. I know that the first meeting that they had had, only one person attended*.

8.2.2. Power and social engagement: Who controls it and why.

Participants show scepticism about the purpose of social engagement. *There's no real progress from meeting to meeting. The further we went through this, the more it was a strategy. You would like to think it was just them bungling along, and not really being across the whole thing. But the more you look at it, it's more of a strategy to delay, confuse you. Then you get tired of it. I spoke to an ex-serviceman and they call it the three Ds: 'Deny, delay, and wait for that person to die'*. The participant who heard this utterance reflects on how his opinion of the Defence Department had hardened overtime: *If I had heard that six months ago I would have been like, 'Come on, that's a conspiracy theory.'* *And now that I know what I know, ...it's absolutely what they do. They just deal with the minister and with press releases. They're already telling us, 'this is what they're going to say at the second and third meeting, fourth meeting, fifth meeting'*. Here, participants are concerned that the meeting agenda is pre-determined, foreclosing the possibility of community-driven issues being included. For example, issues such as information about *how it has been affecting you, or how it might affect you. They're a big bureaucracy so they can say, 'be aware of it, but we've got everything under control. But we're not going to tell you how we've got everything under control'*. *They run their own show. We're dealing with an organization that's incredibly stratified and very powerful*. Research points to the influence of unequal power relations on peoples' distrust. For example, Laird (1989) refers to "the political context of risk communication, the decline of deference and the publics' alienation from, and distrust of authoritative institutions." (p. 543)

A participant is curious about the identity of person who wrote Text 4, *the author at the end, 'Ellen Gray'. I would look up who that is.* They are sceptical about the motives of those responsible for posting Text 4 on the web-site. For example, even though *it does give some good pointers*, they are pointers *about trying to dampen down expectation.* One participant refers to the title, “Managing Expectations at PFAS Community Information Sessions”, and is sceptical about the motive it implies. *It obviously ...is targeted at someone, and how to present (and) do community engagement ..It's from social science perspective. But it seems to be as targeted to ... Defence. Isn't it really?* The possibility that Text 4 is targeted guidance is plausible, since guidance provided by the NEPM (National Environment Protection Council, 2013) identifies its intended readership as “consultants or regulators” (p.1) and its underlying message is about managing community expectations.

It might be no coincidence then that Text 4. suffers the same limitation, albeit with some improvement around the need “to consider community sensitivities when engaging with PFAS-impacted communities, particularly about potential impacts on lifestyle, property values, business and physical and mental health.” (AECOM & Grey, 2019, first page). The improvement might only be an improvement on paper, since as we have seen above, regarding sensitivity to community impacts at Richmond, the written words do not always align with the actions.

Regarding meeting procedure, participants consider that there is an unsatisfactory protocol around RSVPs. *Their third community consultation required an RSVP to come. Now that to me is.. instant put off to your community. I told the EPA. 'you can't do that'.* Following this feedback, there was improvement. The experience of the two participants from Rhodes is different. When there was community engagement about remediation, *there was no RSVP. Anybody could attend whenever they wanted to.* They would advertise that these meetings were on.

8.2.3. Social engagement and building cooperation.

Participants see value in social engagement if it focusses not only on a problem, but as well on a mutually desired outcome. *If they were to engage the community and say: 'We have a problem, this is our strategy, our plan to sort this out', I think everybody would leave the meetings going, 'Right. Something is going to get done.'* It is a way of moving forward.... *That's good for both sides (because) it's chemicals in the*

environment. Most of us don't want the chemical there. You're all on the same side. Here, we see mention of the potential of inclusive social engagement, and the reason why it is needed. As one participant explains, rather than seeing ourselves as being a receiver of government services, or indeed government meddling in our lives, he sees the potential of engaging with government ..in a very positive way. If the chemical is there, then you can argue as much as you like in terms of how to stop that. 'What are we going to do about it'...gives a huge wide open space. The Defence (Department) can then actually develop solutions with the community, because it's all about placating peoples' fears. So it's not about trying tell us 'OK, we're going to get rid of chemicals, and you're all going to be safe' and we will go, 'God, that's great. Now can go back to my life.' In other words, when the community is prepared to be part of the solution by cooperating with those who have responsibility to provide it, there is more potential for success than if the focus is just on the problem. As one participant from the Rhodes community explains, *we worked as a cooperative between us, and it really did help. It was ... cohesive. It was regular. We did five years at Rhodes.*⁶³ *I've come from community consultation that I'd say was really well done. We had a proper committee. In our case, they wanted to do it (site remediation). They ran it properly... making an effort to get to a good meeting. There was a direction.* Here we see support for social engagement because it preferences inclusion, as the NEPM advises (National Environment Protection Council, 2013).

Another feature of the Rhodes social engagement process was support for the local community, which as we have seen in Chapter Six, Section 7, included financial support to engage independent experts. A participant does not see *why there would be any harm in having expert investigations... in order to come to some sort of solid understanding of the extent of the problem. The community can then react to that...and say, 'OK., if that's the situation, then how can we deal with our livestock that's contaminated, or our vegetables, and our children, and our blood and all that.'*

An example of upstream engagement is mentioned by the two participants from Rhodes who had been involved with the Rhodes consultation process. (Homebush Bay Environment Reference Group, 1999; Rhodes Community Consultative Committee, 2009) They explain that *we had done things like this before. We were on*

⁶³ For more detail, see Section 3.6.3.

that committee (for) the remediation of the Olympic site (and) had a bit of information before (we) started. Later in this chapter we will explore what experts understand by the term ‘upstream engagement’ but here, we will allow Escobar (2014)’s definition that it is “early public deliberation around potentially controversial science and technology” (p.480). For these two participants, having *a bit of information before (we) started* suggests, as do Krabbenborg and Mulder (2015), that upstream engagement is useful in building cooperation between different epistemic groups around contested knowledge forms.

I find that:

Firstly, non-experts can recognise the limitations and advantages of social engagement, can identify aspects of fair process that support cooperative social engagement, and have capacity to co-design a social engagement process.

Secondly, non-experts can understand the psycho-social and socio-political context of social engagement, and can understand the motives of risk owners and risk managers.

Thirdly, non-experts recognise clarity and obfuscation in expert texts, can understand competing knowledge forms, and have capacity to engage in meaning-making about risk.

Fourthly, distrust can be the default position of non-experts during social engagement.

To this point, we have made findings about formal guidance on social engagement and non-experts experience of it. Now let’s consider how the advent of the digital age has changed the frame of social engagement

8.2.4. Social engagement in the digital age.

Following full public access to the internet, scientific information became more accessible to everyone who had access to digital technology, and even more so when social media came of age (Macnamara, 2014). Beck (2016)’s idea of the metamorphosis of the world is also in play around a new paradigm of social existence “no longer a world made up of nations, but a second modernity” (p.21).

The digital age has changed the frame of social engagement and given more power to non-experts, should they wish to take it. In the pre-digital age, media was owned

and controlled by private corporations or government, and they had power over the distribution of risk knowledge. Today non-experts can create or participate in social media and communicate their own knowledge and values to a global audience. This changing frame of risk communication releases a potential for an increasingly contested risk dialogue, and a potential for enhanced cooperation between different epistemic groups.

A key function of the internet is around knowledge availability. While still allowing for privileged knowledge, it also allows what was formally privileged knowledge to become public knowledge, for example, inter-governmental deliberations about POPs risks (United Nations Environment Programme, 2017). Moreover, NGOs and concerned scientists can produce their own risk knowledge, including about the under-estimation of PFAS risks to health. For example, the Helsingor Statement (Scheringer et al., 2014) and the Madrid Statement (Ovokeroye et al., 2014). Less well-resourced NGOs can use the Internet to draw public attention to reports, policy and planning statements, and they can create their own risk dialogue, including about PFAS risks. For example, as of 29 December 2019, Pickford (2020) identifies a minimum of twenty-five social media sites in Australia, as well as thirteen overseas sites. As we have seen from focus group discussion, non-experts use the internet to get answers to questions that experts will not, or cannot answer. Overall, the balance of power might still favour the expert, however experts no longer have exclusive control of risk information. Non-experts can participate, if not as equals, then as legitimate participants in a risk dialogue.

So how do experts understand the influence of digital technology on social engagement and risk communication? Drawing on data from the in-depth interviews, I find that experts understand that the advent of the internet allows non-experts increased access to expert knowledge, and that this can change the balance of power during of social engagement. For example, *engagement in terms of managing perceptions has shifted over the last 20 years...because of the internet. Suddenly there's a whole lot of information out there...Knowledge is probably higher...It's easier to do research. Lay people get a very good understanding of issues. Everyone is suddenly an expert and has access to information instantly.*

Multiple new sources of knowledge create challenges for experts. They allow for a wide variety of opinions and judgements about scientific issues, and whilst empowering non-experts, can also mislead them. For example, *you don't know whether its real (or) fabricated evidence*. There is *misinformation based on google, or alarmist stuff on the internet*. *It's always frightening and usually your client doesn't want you to mention nasty words like cancer and death, but they are easy enough to find out*. *That's always an interesting and challenging aspect*. *We had some people...who made an art form of looking it up on the internet, and getting it right or wrong, depending on what...pre-suppositions were*. In this way, experts understand that the digital age supports the creation of multiple risk dialogues about the same risk phenomenon.

Experts understand that the new knowledge landscape can be of benefit to stakeholders, including themselves. There is *very optimistic stuff on the internet*. *Websites are good... from a professional perspective*. *You can...update the content*. *It also allows a degree of two-way communication so you can have a contact page...People will email in*.

These examples show that experts can appreciate that the internet can provide new opportunities to improve the quality of social engagement. Experts can also recognise new responsibilities that result from the new knowledge landscape. They position them around their *social license to operate*, a term that parallels *the way someone or an organisation goes about obtaining a license to do something*. A social license to operate confers *approval*, gives an expert *permission...to carry out an activity from a remediation sense and community perspective, not just the regulatory community*. It involves *trying to conduct its business so that it doesn't impinge .. negatively, but actually contributes positively where possible*. *The same...level of rigour and expectation of both sides are presented in this social license*.

Experts understand that a *social license to operate* can be difficult to achieve. As one expert explains, *in relation to community acceptance and social licence*, and *Dr. Google,.. it seems like the social acceptance...of uncertainty is being questioned more and more*. Van Asselt and Vos (2008) are aware of this when they lament the difficulties around solving the uncertainty paradox. As we have seen in earlier chapters, empirical risk is often at odds with non-experts' understanding of it, so at this

point, let's explore what experts think about this groups' capacity to understand what remediation is.

They consider that communities are all unique. We had a whole range of views and knowledge that ranged from nothing or misinformed, to moderately well informed. The majority of...people did understand what was happening, very much capable of marshalling evidence. On the other hand, there are those who are not. It can be pretty much zero. They may not understand what the word remediation means, have bigger fish to fry or have little...interest. There's a distinct lack of education or technical background. They didn't understand what the baseline figures were, whether or not any increment is...significant.

Experts understand that people may choose not to accept experts' explanations of remediation processes. For example, they are *prepared to let themselves be led...willing to take a side without being fully informed. Residents will draw on people they think are more expert in the area...If they're not careful, they can get more activist type inputs which don't necessarily reflect what is a rational, scientific assessment of the risks.* On the other hand, people might trust experts because *they assumed they were being provided information in good faith.*

To conclude, I find that:

Firstly, experts and non-experts can understand the power of the internet to improve or degrade a risk dialogue.

Secondly, non-experts use the power of the internet to enhance their contribution to a risk dialogue.

Thirdly, experts can understand the concept of a social licence to operate.

To this point, we have made findings and formal guidance on social engagement, and non-experts experience of it, and about the positioning of experts and non-experts in the digital age. Now we provide findings about experts' understanding of the language of social engagement.

8.3. Findings from a questionnaire.

Findings were generated from the key terms questionnaire. It measured experts' capacity to understand the meaning of terms associated with social engagement processes which lie within a domain of knowledge unfamiliar to the majority of experts.

The terms are from the social sciences and identified Chapter 2. They are 'mandated science', 'transfer of risk', 'upstream engagement', 'grey literature', 'stakeholder', 'community' and 'risk perception'. Twelve of the cohort of 17 completed the questionnaire. I began the analysis by comparing the degree of alignment between experts' explanations and the definitions, and followed with thick description.

See Appendix 8.1. Key Terms Questionnaire. Definitions of seven terms from the social sciences.

Three categories of alignment were selected: Sufficient, Limited and Non-compliant. A fourth category was provided to record other responses. There was variation in the degree of alignment. Three explanations were sufficiently aligned with the definition (= or >6/12). They were explanations about 'stakeholder' (11/12), 'risk perception' (9/12) and 'community' (8/12). The remainder were otherwise distributed, with the least sufficiently aligned explanations being about 'mandated science' (2/12) and 'upstream engagement' (3/12). Table 8.3 below summarises the findings.

Lack of alignment suggests that experts do not understand the meaning of terms. To explore this possibility, I undertook further analysis via thick description, comparing experts' explanation of the meaning of terms with their definition. Three of the seven terms were selected for analysis on the basis that the explanations provided were the least well aligned with the definition. I established this by calculating the sum of the total responses that attract sufficient and limited alignment: Mandated science attracted 3 of a possible 12 responses, and upstream engagement and grey literature both attracted 5.

Key Terms Questionnaire: Social Sciences Alignment of experts' explanation of 7 terms with selected definitions n=12/17						
Terms	Sufficient	Limited	Total responses aligned	Non-compliant	Other	Total
Mandated science	2/12	1/12	3/12	3/12	6/12	12
Upstream engagement	3/12	2/12	5/12	5/12	2/12	12
Transfer of risk	4/12	6/12	10/12	1/12	1/12	12
Grey literature	5/12	0/12	5/12	1/12	6/12	12
Community	8/12	3/12	11/12	0/12	1/12	12
Risk perception	9/12	3/12	12/12	0/12	0/12	12
Stakeholder	11/12	1/12	12/12	0/12		12

Table 8.3. Results. Key Terms Questionnaire (Social Sciences).

'Mandated science' is defined "as when scientific evidence is interpreted for the purpose of making policy recommendations" (Driedger et al., 2002 p.790). Experts explain it, for example, as *science commissioned by an authority such as a government department or agency or science used for policy-making*. Here, experts show an awareness that boundaries exist between their form of scientific knowledge, and its' newer application created specifically for the purpose of decision-making.

I defined upstream engagement as social engagement that occurs prior to the mobilisation of a project. It aligns sufficiently with Escobar (2014)'s simple definition of "early public deliberation around potentially controversial science and technology" (p. 480), and also with Krabbenborg and Mulder (2015)'s more complex definition around "the early stages of research and development trajectories" (p.453). Experts explain upstream engagement in terms of timing or intent, for example in terms of getting input from the public *early in the process or discussion of early planning/design option stages of a project*. One expert explains that upstream engagement is *stopping the problem before it becomes an issue*. In other words, it pre-empts, or addresses problems through anticipation and action.

Grey literature is defined as “research that is either unpublished or has been published in non-commercial form, and includes government reports, policy statements and issues papers” (University of New England, 2019) Experts explain it as knowledge that *has not been through a formal process of peer review, or not fully assessed*. Examples include *personal opinion and anecdotal material...sources on the internet, a working paper or reports...by government or industry*.

To this point, we find that some experts are able to understand the meaning of ‘mandated science’, ‘upstream engagement’ and ‘grey literature’ sufficiently well, and that others struggle to do so. Some experts venture a provisional explanation of the terms when they use phrases like *would guess it may mean, or imagine it relates to*, whilst others lack any awareness of the terms. They were *not familiar*, or had *not heard of this term before*. Other experts misunderstand the meaning of terms. One suggests a policy framework when positioning ‘mandated science’ around what is *required by law*, but this explanation is off the mark since it implies compulsion rather than an evidence base for public policy. Another interpretation is that mandated science is *an accepted basis...the nominated methodology*. Here, the meaning of the term is inappropriately positioned around scientific proof, rather than the result of a mix of scientific, and administrative or political factors. One expert provides an interesting insight when he dismisses the term as *superfluous*. *Science either is or isn’t, it cannot be mandated*. Here, he positions science as a distinct knowledge form that cannot extend beyond its boundary, where the scientific method is no longer the dominant mode of reasoning.

‘Upstream engagement’ is misunderstood by experts as associated with a hierarchy of professional expertise or organisational power, rather than around the timing and intent of engagement. It is around *experts or people with knowledge on a particular subject, people in more powerful positions or in a position of power, be it statutory, financial, political*. Another description is imaginative, but still wide of the mark since upstream engagement is explained literally as *pollution that has been transported away from its source, like a river washing contamination “downstream”*. *In decision-making, let’s involve the people and places and facilities that are at the source*.

‘Grey literature’ is misunderstood as *technical information or scientific literature*. One expert uses the word *inclusive* to describe it, implying that some expert content may

be more accessible than others. This explanation fails since a characteristic of some grey literature is its confidentiality, not its accessibility, as shown in the review of popular non-fiction in Chapter Two.

To conclude, I find that:

Firstly, experts vary in their capacity to correctly define key terms associated with the language of social engagement.

Secondly, experts vary in their capacity to understand the meaning of key terms associated with the language of social engagement.

In the next chapter, I consolidate all findings about the knowledge, understanding and experience of experts and non-experts.

Chapter Nine. Synthesis.

In this chapter, I conclude my research inquiry by consolidating the findings, making claims, and proposing a new model of risk communication. I show that the findings warrant my claims regarding experts' capacity to bridge communication gaps between themselves and non-experts, and might warrant my claim regarding a new model of risk communication.

Regarding the latter, my findings might be amenable to generalisation beyond the specific content of the inquiry. They could provide sufficient weight of evidence to warrant my claim regarding the credibility of a new model of risk communication. However, although these findings provide a reasonable weight of evidence, any claim to generalisability must wait until it is tested in an actual situation.

Regarding findings about experts' capacity to bridge communication gaps, these are warranted claims specific to my case study of Australian remediation experts. As noted at the beginning of this inquiry, the unit of analysis is 'the expert', the phenomenon of interest is POPs destruction technology, and the situation is social engagement about remediation risks. Empirical data was generated about all three, and the findings provided a sufficient weight of evidence to warrant the specific claims.

All findings pertain to content and processes that experts use, and support the creation of the two constructs, *the persona of the expert* and the *socially literate expert*, and to acts by experts which embody *the practice of trust*. Together, they provide a way to answer the first research question. It asks if there is evidence of expert content and processes that can bridge gaps in knowledge and understanding between experts and non-experts who participate in social engagement processes about pollution remediation in Australia.

The weight of evidence I bring forward has been generated by the analysis of data using six tools of inquiry: in-depth interviews, a focus group, two surveys and two questionnaires. The strands of evidence they generate are sufficiently numerous to create a cable of reason as Peirce requires (Anderson, 2005), and, as he also requires, these strands are intimately connected, since they derive from analysis of the perspectives of experts and non-experts about the same things.

In my inquiry, the strongest strands in the cable emerge from thick description analysis of data from the in-depth interviews and a focus group, and from semiotic analysis of focus group data. Grammatical analysis of data gathered from in-depth interviews generates corroborating evidence, as do the Key Terms and Milestones Questionnaires. These latter tools of inquiry generate sufficiently strong, albeit more slender strands of evidence, as does the image survey. Findings from the media survey are the slenderest, and their value lies in the insight they provide about the increasingly mutable meaning of a key word used by experts during risk communication:-

9.1. The cable of reasoning described.

As explained in Chapter Three, Section 3, I adopted the abductive mode of inference that Peirce (1931) promotes as a way to generate evidence. He explains abduction as “the process of forming an explanatory hypothesis...(and) suggests that something may be... If we are ever to learn anything or understand any phenomena at all, it must be by abduction” (S.4. 171, underlining added by the researcher). The key here is the phrase “may be”, since it infers the possibility of something occurring in the future. It is in this way that abductive reasoning allows multiple strands of evidence to remain in play as an inquiry continues, and at its conclusion combine to form a cable of reasoning (Anderson, 2005; Johnson & Onwuegbuzie, 2004; Tavory & Timmermans, 2014).

In the Peircean schema, strands of evidence can be either slender or thick, and if they are “sufficiently numerous and intimately connected”, as Peirce requires, they can form a defensible pattern of findings. (Johnson & Onwuegbuzie, 2004, p.18) Johnson and Onwuegbuzie (2004) acknowledge Peirce when they bring forward the idea of warranted assertability which offers fallibilism as a way to make claims. Fallibilism allows that “research conclusions are rarely, if ever, viewed as perfect, certain or absolute...Justification comes from warranted assertability” (Table 1., p.18). Similarly, Armstrong (2010)’s approach to making warranted claims requires that conclusions need to be supported by evidence that follows “logically from the design of the study, including the review of pertinent literature, data collection, analysis , interpretation, and the researcher’s inferential process” (p.882).

In this approach to truth finding, the researcher aims to “obtain warranted evidence that provides us with answers that are ultimately tentative ...but in the long run...moves us toward larger truths” (Johnson & Onwuegbuzie, 2004, p.18).

My claims are based on these approaches. The findings generated from the analysis of six sets of data allowed multiple strands of evidence to emerge and a pattern of findings to develop. From that point, I fashioned them into a cable of reasoning as a way to warrant my claim for the validity of two provisional constructs, *the persona of the expert* and *the socially literate expert*, and to warrant my claim about the possibility of *the practice of trust*. These two constructs and the associated *practice* were first suggested from the findings of my abductive inquiry (Chapters Four to Eight), and this prompted me to hypothesise them as warranted claims when I wove findings about them into a cable of reasoning.

The question now is whether the cable of reasoning provided here is sufficient to warrant the claims. Is there another way to generate a sufficient amount of provisional evidence? Hopwood (2016)’s ’s metaphor of a fishing net comprising a pattern of well woven strings offers one way. He explains that “evidence or data can only ever be provisional, a pattern of well woven strings that hold up a bulkier mass, rather than a seamless continuous entity. Analysis is...like weaving threads to make a net”. (Hopwood, 2020). I represent Hopwood’s schema in Figure 9.1. below.

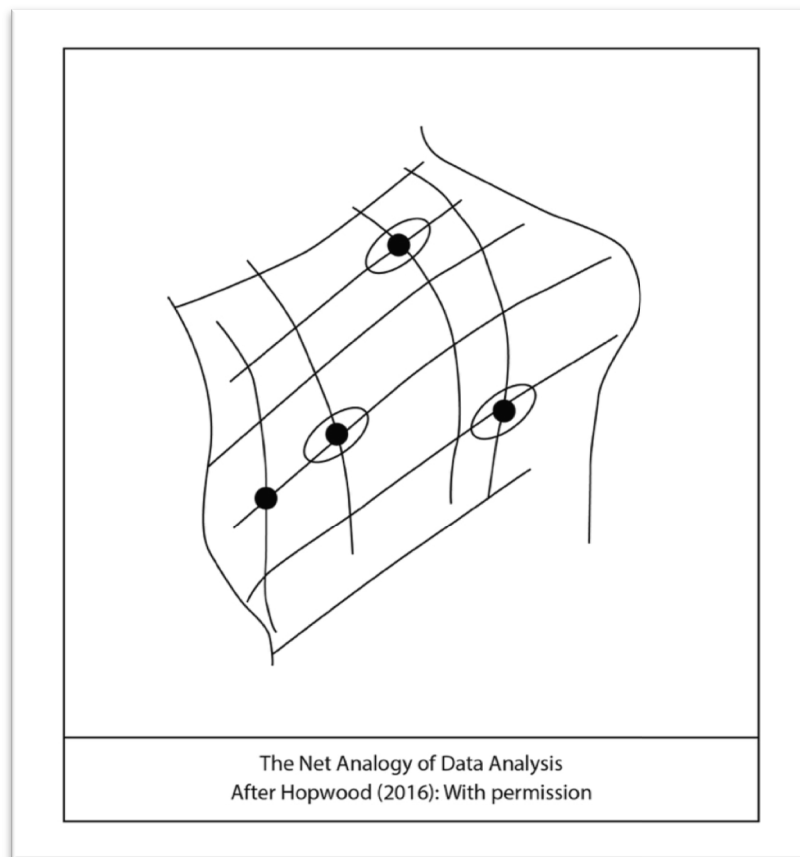


Figure 9.1. Representation of Hopwood's net analogy. Source: Author's representation.

The net, with its “pattern of strings” represents a different approach to the Peircean method which relies on a cable of reasoning that leads to a position where warranted claims can be made. Both approaches are sufficient to support a claim-making process, and I have chosen the latter, which allows for strands of evidence to vary in strength, rather than conform to what is needed in a well-made net, where all strands need to be of equal strength. Miles et al. (2014)’s guidance is relevant here. They find no problem with the fact that some data are stronger than others since there are reasons as to why. In their schema, what the researcher must do is acknowledge that this is the case, and use the “weight of evidence” to defend conclusions. (p.300)

In Figure 9.2 below, I provide a visual representation of my method of inquiry, drawing on Boeije (2002)’ idea of a “code tree” (p.397).

In the following sections, we consolidate all findings generated by the inquiry.

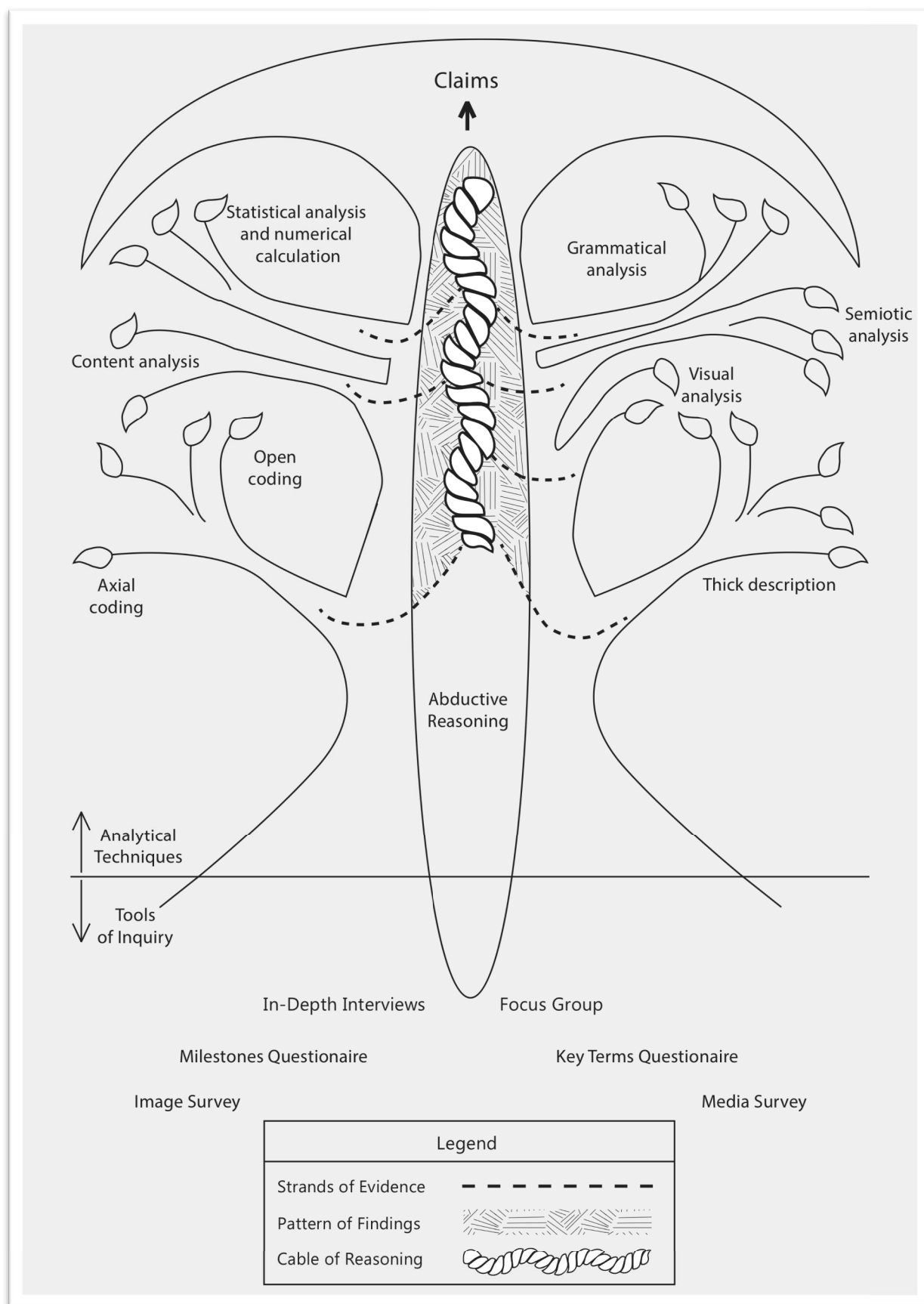


Figure 9.2. A tree of reasoning.

9.2. Consolidation of findings: The role of situational and self-awareness during a risk dialogue.

I start the process of consolidating findings by positioning the expert's awareness of self and situation as a critical determinant of effective risk communication.

Awareness of self requires acknowledgement of one's own values, life experience and financial interests. Situational awareness requires an individual's awareness of the socio-economic and socio-political aspects of a phenomena. For this inquiry, the phenomena is POPs remediation technology, and when explaining its risks, experts require awareness of the possibility of conflict between their own and other peoples' values, recognition that different experiences of past pollution risks shape attitudes to the risk, recognition that technological processes subject others to involuntary risk, and recognition that there is a role for trade-offs regarding the selection of risk levels.

Table 9.1 below provides findings from different chapters of this dissertation about experts' capacity for awareness of self and situation. The findings are sufficient to allow alignment with two of the integration mechanisms that emerged in the literature review. As explained in the review, I define integration mechanisms as mental processes or knowledge forms that encourage cooperation between different epistemic communities to achieve jointly desired and compatible outcomes. (see Figure 2.7.)

The integration mechanisms that apply to findings about self and situation are 'awareness of the mental context of risk' and 'fair process'. Taken together, they constitute evidence of the expert's capacity for conscious awareness, a personal quality that they need if they want to communicate effectively, and be part of a process based on cooperation and common goals.

Findings: The expert's awareness of self and situation	
Self-awareness	Ch.
Experts can recognise that, as individuals, they have limited capacity to resolve tensions between public and private values. When experts understand public and private values, they can become aware of the socio-political context of commercial activities.	4
Situational awareness	
Experts can identify financial and social aspects of company values. Experts can distinguish between the financial and social aspects of corporate responsibility and understand that there can be tension between them. Experts are aware that technological changes over time govern the level of empirical uncertainty associated with pollution risks. Experts' understanding of company values, corporate responsibility ..can support their awareness of the socio-political context of commercial activities. Experts can recognise milestones when ...they suggest values that align with their private values around justice and human rights, and when they are associated with their areas of expertise. Experts can associate milestones with the psychosocial context of pollution and can retain a memory of pollution which contributes to their understanding of this context. Experts can lack interest in, or awareness of, events and situations that occur in national or international jurisdictions.	4
Experts can reduce non experts' perceptions of risk when they exhibit situational awareness.	5
Situational awareness during a risk dialogue allows for awareness of 'the other' as well as 'the self'. When experts exhibit situational awareness, they can build and retain the trust of 'the other'. When experts lack situational awareness, they can create distrust between 'the self' and 'the other'. Building and retaining trust requires recognition of the psycho-social and socio-political factors that are in play during social engagement. The retention of trust during social engagement requires a fair process. Experts can identify aspects of fair process that support cooperative social engagement A successful risk dialogue requires that trust is operationalised as an act, rather than spoken of in the abstract. A successful risk dialogue requires that both distrust and trust remain in play for its duration Distrust can be the default position of non-experts during social engagement. 'Critical' or 'provisional' trust are more useful constructs than 'trust' in situations where experts need to be trusted.	6

Experts can understand the nature of their target audience. Experts can understand the construct of involuntary risk , can recognise situations where risk is unevenly distributed on socio-economic lines and can understand that situations where involuntary risk is in play require negotiation to ensure trade-offs .	7
Non-experts can recognise the limitations and advantages of social engagement, can identify aspects of fair process that support cooperative social engagement, and have capacity to co-design a social engagement process. Non-experts can understand the psycho-social and socio-political context of social engagement, and can understand the motives of risk owners and risk manager. Distrust can be the default position of non-experts during social engagement. Experts can understand the concept of a social licence to operate.	8

Table 9.1. Findings: The expert's awareness of self and situation

9.3. Consolidation of findings: *the persona of the expert.*

In this section, I continue the process of consolidating findings by providing evidence that supports the construct that emerged from analysis in Chapter Six, and named *the persona of the expert*. As with expert's awareness of self and situation, I position the expert's *persona* as a critical determinant of effective risk communication. As I find in Section 6.11, *the persona of the expert* has four facets that support the capacity of the expert to communicate effectively. They allow the expert to function as an individual, as an emotional being, as a professional and as a communicator.

Here I consolidate findings about each facet and align them with one or more of the integration mechanisms identified in the literature review. By this process, I confirm the validity of the construct of *the persona of the expert*.

The first facet of *the persona* is about the individual. Experts exist as individuals who are a member of society - a person who lives in a home and a community just like everyone else. As individuals, they have a unique life experience and possess a set of morality-based values. Their values tend to the traditional in that they associated them with honesty and *being true to yourself*. They also reflect the Australian value of 'a fair go', and show a preference for the equality of all people.

Table 9.2 below provides findings taken from different chapters of this dissertation about the expert as an individual. The findings are sufficient to allow alignment with the integration mechanisms 'awareness of the mental context of risk' and 'awareness

of the physical context of risk'. Taken together, they constitute evidence of the expert's capacity to express themselves as an individual, a personal quality that experts need if they want to communicate with non-experts, and be part of a process based on cooperation and common goals.

Findings: The expert as an individual	Ch.
Experts are experienced professionals, are well-educated and well-travelled and are curious about the world. Experts can understand the meaning of private and public values and can explain why there are tensions between them. Experts can hold strong views around ethical issues and are aware of the ethical aspects inherent in the time lag phenomena. Experts can display a set of attributes that contribute to a particular type of <i>persona</i>. Non-experts consider experts as individuals rather than a uniform group, and ascribe different meanings to the construct of 'the expert'.	4
Experts can understand that knowledge transparency is limited by ethical guidelines on confidentiality.	6
An individual's personality influences their capacity to communicate with a target audience. Descriptions about the meanings of empirical uncertainty provided by experts align with ...findings about their understanding of the ethics around risk distribution. Experts can understand that risk dialogues are underpinned by competing motives	7

Table 9.2. Findings: The expert as an individual

The second facet of *the persona of the expert* is about the emotional being. When faced with challenges inherent in a risk dialogue, experts can respond by expressing, or stimulating in others, both positive and negative emotions, all of which can support or confound cooperation between different groups.

As emotional beings, experts can recognise why non-experts might express negative emotions towards them personally, or around a risk, be it empirical or perceived. Experts can know how to communicate their knowledge in a sensitive and respectful manner so that non-experts can understand it, and can know why it could be useful. In this sense, experts can know their audience, in that they can deliver suitable risk knowledge, not only because they know what a risk could imply and why it is relevant to non-experts, but also because they know how to communicate with them without condescension. Here, the expert can refer to benefit as well as risk and invite non-

experts “to see the world anew...to creatively focus attention on another domain” as suggested by Barrett and Cooperrider (1990). In their schema, scientists can be “attuned to...and aware of...the power of metaphor...(its) potential for directing perception, enriching awareness and transforming the world” (p. 227).

Experts can understand the meaning of empathy and they can express empathy towards non-experts. They can distinguish between empathy and sympathy but might not always speak with compassion, as one formal guidance document advises that they do (US EPA, 1988). Expressing compassion when outrage is in play around illness, disease and reproductive dysfunction might be out of place. It might be seen as confected emotion and turn people off, seem impolite or insincere, or lull people into false sense of security that experts understand their pain, only to find out later that their confidence in them to do so was misplaced.

These findings about experts’ range of emotions are sufficient to allow alignment with the integration mechanism ‘awareness of the mental context of risk’, Another integration mechanism is ‘improved communication through imagery” and again there is alignment since experts are aware of the need to select imagery with the viewer’s perceptions in mind.

Table 9.3 below provides findings taken from different chapters in this dissertation about the expert as an emotional being. Taken together, the findings constitute evidence of the expert’s capacity to function as an emotional being, again, a personal quality that experts need if they want to communicate with non-experts and be part of a process based on cooperation and common goals.

Findings: The expert as an emotional being	Ch.
Experts can understand the psycho-social context of pollution.	4
Experts can understand that perceived uncertainty is shaped by the experiential mode of thinking which preferences the senses, experience and memory. Experts can understand that perception of a risk is amplified when people draw upon their experiential mode of thinking. Experts can reduce non experts' perceptions of risk when they provide credible information over time and when they accept the validity of non-expert knowledge forms.	5
Experts can show positive and negative emotions during a risk dialogue. Experts can connect the capacity to empathize with past personal experience. Experts can exhibit empathy towards non-experts and can explain how they do this.	6
Experts understand that when they select imagery for use during risk communication, they need to keep the viewers' perceptions in mind.	7

Table 9.3. Findings: The expert as an emotional being

The third facet of *the persona of the expert* is about the professional. In their industry, experts need to perform at a high level in a multi-disciplinary and economically challenging commercial environment. When a strong weight of scientific knowledge and technical competence is needed to manage, reduce or eliminate empirical risk, experts need to draw upon their capacity as professionals. When they do, they can explain why there is variation in research methodologies, why there are differing criteria for evidence and how changes to measurement instrumentation and risk assessment criteria have changed over time. When they can explain how scientific evidence is constructed, they can freely admit to the risks, because they are calculable, assessable and manageable.

However, when experts rely solely on scientific information to explain what they consider to be a tolerable risk, they can fail to communicate its meaning, since a risk can mean something different to those who are involuntarily subject to its impact. When experts speak of tolerable risk, they might invoke outrage from non-experts who reject any imposed risk, even demand zero risk or guarantees of total clean-up of the environment. As statisticians and philosophers might agree, zero risk can only exist when there is no hazard. In remediation situations there always are hazards, so there is always a risk. Now total elimination of risk is theoretically possible, and on these

grounds might be demanded by an outraged or ill-informed community, but it is likely to be economically non-viable (Thiess Services Pty. Ltd & Parsons Brinkerhoff, 2002). The early experience of the Superfund initiative demonstrated how the zero risk approach failed to get remediation established, because people wanted total clean-up and sought this unachievable remedy through the courts (United States Environmental Protection Agency, 1996).

Aven (2007)'s discussion about ethics of the mind and the ethics of consequences applies here. In this schema, the ethics of the mind is in play when a community demands zero risk despite the potential for commercially unviable cost blow-outs. In this situation, "an action is justified by reference to its purpose, meaning, or intention" in that "the rightness of an act is not determined by its consequences" (Aven, 2007 ,p.304). This goes some way to explain any ethical tension between experts and non-experts about the selection of risk levels. The question is how can experts resolve the tension. How do they respond to the challenge of communicating empirical uncertainty without making non-experts feel outrage, fear, anxiety or worry? Applying Aven's schema, they can do so by invoking "the ethics of the consequences" whereby "the rightness of an action is totally determined by the consequences of the action" (Aven, 2007 p.304). This schema aligns with experts' way of thinking, since they can draw on their capacity as professionals to explain that whilst they cannot deliver zero risk, they can reduce the risk to acceptable levels. In other words, they can address the paradox of progress, as explained by Van Asselt and Vos (2008).

These findings are sufficient to allow alignment with three other integration mechanisms. One is 'awareness of the physical context of risk' and it allows a role for site location and history to shape the context of the risk and support effective risk communication, including around environmental amenities and social inequality. Another is 'the need to balance the contribution of different knowledge forms' and it requires that expert knowledge needs to be accurate, accessible and credible when it is prepared for consideration by non-experts. Another is 'awareness of the mental context of risk' and it is here that the key issue of trust in experts is in play.

As professionals, experts require knowledge of the workings of the corporate world and how it functions within broader society, where distrust and lack of confidence in the integrity, independence and professional judgement of experts is always present.

Regarding their integrity and independence, as professionals, experts need to draw upon the experiential mode of thinking to understand why these qualities are important to others, and to draw upon their analytical mode of thinking to explain how they can exercise a degree of independence. Slovic et al. (2004)'s dual mode of thinking is in play here, and again, as with the emotional facet of *the persona of the expert*, we see alignment between the professional facet with the integration mechanism 'awareness of the mental context of risk'. Ropeik (2011)'s proposal about the contest between evidence and feelings applies here, as does M. R. Greenberg et al. (2012)'s positioning of the two modes as operating in parallel (p.772).

Table 9.4 below provides findings taken from different chapters of this dissertation about the expert as a professional. Taken together, the findings constitute evidence of the expert's capacity to function a professional. As with other facets of *the persona*, it is a personal quality that experts need if they want to communicate with non-experts and be part of a process based on cooperation and common goals

The fourth facet of *the persona of the expert* is about the communicator. Being able to communicate is not in itself sufficient to allow effective risk communication. A person can be an effective communicator, but have nothing much to say, or they could be strong on the process of information delivery, but weak as far as content goes. To communicate effectively during a risk dialogue, experts are required not only to deliver content to non-experts, but to select suitable content. Before speaking to others, experts would think about, and prepare the information they are going to present to non-experts, what they are going to show them, and what experiences they will provide them with. To do this, experts will draw upon their scientific literacy to select the appropriate scientific content.

Scientific content is always required during a risk dialogue, but if experts select content that is only about empirical risk, they can fail to communicate because non-experts have concerns and expectations about risk that are unique to themselves and, therefore understand remediation risks differently to them. Just presenting the facts about a risk without its' context can lead to gaps in communication, a potential situation that is reflected in the dialogue model of risk communication, as explained by Irwin (2007). To deliver effective scientific content, experts are required to draw on both

analytical and experiential modes of thinking, as reflected in mental models of risk communication (Morgan et al., 2002).

Findings: The expert as a professional	Chp.
Experts have some capacity to apply both analytical and experiential mental states to their understanding of risk and risk situations.	4
Experts can understand that empirical uncertainty takes different forms, is represented in various situations, and shaped by different factors around the attributes of the physical world and scientific knowledge. Experts can reduce empirical uncertainty by applying analytic mental processes that address risk situations.	5
Experts consider constraints on transparency as a normal part of professional life. Experts can understand that knowledge transparency is limited by practicality, by laws around privacy, by commercial constraints, or by the complexity of knowledge forms. Experts can acknowledge the role of professional judgement in decision-making around risk and that commercial factors play a role in risk selection. Experts can acknowledge that experts' independence can never be absolute and that they can negotiate the level of independence via a contract. Experts can identify internal management processes that support their professional integrity and can be aware that there are limits to the effectiveness of corporate checks and balances. Experts can understand that trust in them is associated with their professional integrity, transparency, and independence from private commercial interests, and that distrust is associated with their lack. Experts can understand that confidence in them is associated with their proven competence in their chosen domain of expertise. Experts can understand that the flexibility required by remediation projects has the potential to undermine their integrity.	6
Experts acknowledge that science can never provide conclusive evidence of safety. Experts can vary in their capacity to correctly define the key terms associated with the bio-physical sciences. The formula <i>risk equals hazard plus outrage</i> has limitations associated with empirical measures and constructs. Experts' descriptions about the meanings of empirical uncertainty ..align with (other) ...findings about their understanding of, and competence to reduce risk, with their capacity to communicate that they are competent and with their awareness of commercial constraints on their activities.	7

Table 9.4. Findings: The expert as a professional

Drawing on both modes allows experts to understand why communication gaps between themselves and non-experts exist. Again, we see alignment of a facet of *the persona of the expert* with the integration mechanism ‘awareness of the mental context of risk’. As professionals, a critical aspect of their risk communication is the capacity to address the uncertainty paradox.(Van Asselt & Vos, 2008) The paradox allows that whilst empirical uncertainty is inherent in science and technological processes, experts’ assessment and management of risk provides for a sufficient level of certainty because there is an agreed level of risk embodied within a remediation process. In this regard, experts are confident about their capacity to explain empirical uncertainty and how they address it, using their knowledge about the relationship between a hazard and the risk, and uncertainty implied by risk. Experts can explain that remediation exists to reduce empirical risk, rather than increase it. Luhmann argues that experts can do this when they allow “any question of what happens in those areas of knowledge in which intersubjective certainty cannot be attained” (p.21). In a similar sense, Wynne (1988) wants scientists to be conscious of their allowable boundaries, including willingness to explain “ad hoc judgements and assumptions” (p.51).

Table 9.5. below provides about the expert as a communicator. Taken together, the findings constitute evidence of the expert’s capacity to function as an effective communicator. Again, this is a personal quality that experts need if they want to communicate with non-experts, and be part of a process based on cooperation and common goals.

Regarding how to deliver content, experts can identify textual and non-textual language forms that are useful, and vary in their assessment of what works and what does not. Some experts can select useful tools that enable them to communicate the risk knowledge that they have selected, and some cannot. The findings align with two integration mechanisms: ‘Improved communication through narrative’ and ‘Improved communication through imagery’.

Table 9.6. below provides further findings about the expert as a communicator. Taken together, the findings constitute evidence of the expert’s capacity to function as an effective communicator. Again, this is a personal quality that experts need if they want to communicate effectively, and be part of a process based on cooperation and common goals.

Findings: The expert as a communicator	
Communication using dual modes of thinking	Ch.
Experts can recognise that the presence of two, contemporaneous modes of thinking can generate a misalignment of meaning between empirical and perceived uncertainty. Experts can reduce any misalignment of meaning between empirical and perceived uncertainty when they allow a place for the experiential mode of thinking.	5
Descriptions about experiential meanings of empirical uncertainty provided by experts align with existing findings about modes of thinking about empirical risk, with professional, commercial and social contexts around risk selection, and with the temporal context of risk. Experts can draw on deficit and mental models of risk communication to explain the meaning of scientific terms. Non-experts can use both the analytical and the experiential mode of thinking, and allow for interplay between them. Non-experts use abduction when they assign different meanings to the same object.	7

Table 9.5. Findings. The expert as a communicator: Communication using dual modes of thinking.

Findings: The expert as a communicator Communication using textual and non-textual language	
General findings	Ch.
Experts use a mix of traditional and digital media forms.	4
Experts can function as communicators when they use both textual and non-textual language to construct a risk message, and when they use integrated image forms to enhance the meaning of the risk message.	7
Experts can understand the importance of using a variety of platforms to communicate with their target audience. Experts and experts can understand the power of the internet to improve or degrade a risk dialogue. Non-experts use the power of the internet to enhance their contribution to a risk dialogue	8
Findings: The use of textual language	
Experts can have sufficient language skills to communicate that they are competent to manage uncertainty and reduce risk. Experts can communicate that they are competent. Building and retaining trust involves action by the expert. If experts loose to control of a risk message, or do not cooperate with each other, they can lose the trust of others. Experts use of language assists them to accurately describe the meaning of empathy. Scientific language can give the impression of lack of empathy.	6

Experts can understand the importance of using a variety of platforms to communicate with their target audience. Expert risk messages can be informative, accessible and useful, and can contain inconsistencies, be misleading, inadequate or inaccessible. Experts need to apply design and content criteria to any text before they post it on digital media or use it during risk communication with non-experts. Experts can function as communicators using textual language with the attributes of description, the vernacular, comparison, example, analogy, narrative techniques, and when they use verbs that bring elicit the senses, explain a function or imply compulsion. When experts select these attributes, their language has sufficient clarity and depth to explain the meaning of scientific terms, as distinct from providing their definition. Verbs have the power to convey the possibility, probability or actuality of human action. When experts use verbs that convey an obligation or compulsion to act, they can acknowledge uncertainty and provide for certainty. Experts can explain their responsibilities, and their competence and capacity to manage and reduce risks.	7
Non-experts recognise clarity and obfuscation in expert texts, can understand competing knowledge forms, and have capacity to engage in meaning-making about risk	8
Findings: The use of non-textual language	
Experts can function as communicators when they use integrated image forms to enhance the meaning of the risk message, and when they select imagery and artefacts that align with the meaning of the risk message Experts can distinguish between use and non-useful image forms. Lack of context can confound or distort the intent of a risk message. Experts need to apply design and content criteria to any image they post on digital media or use during risk communication with non-experts. Simple images are an unsuitable form of risk message because they lack context and stimulate unpredictable heuristic responses. Complex images, including maps, are a suitable form of risk message when they are created using appropriate design principles. Suitable design features include composition, selection and identification of, and relationships between, features, the use of icons, colour and shading. When design principles are absent, maps can confuse non-experts, or reinforce a cynical or distrustful attitude. Experts can understand that artefacts are useful in risk communication when they align with the purpose of the risk communication, or can confound a risk message when they are used in an unsafe or irresponsible way.	7

Table 9.6. Findings. The expert as a communicator: Communication using textual and non-textual language.

To this point, we have established that all four facets of an expert's *persona* must be in play if the expert is to undertake effective risk communication with non-experts.. Moreover, as explained at the completion of Chapter Six, *the persona* needs to be sufficiently balanced- not too much light-weight communication at the expense of measured professional input, the right amount of projection as an individual, and willingness to express emotion where appropriate, whilst at the same time being in control of emotions. Let's unpack this a little more.

During a risk dialogue, some experts might always achieve sufficient balance, whilst others may do so sometimes, or be completely out of their depth. For example, if experts draw solely upon their capacity as communicators, their effort to do so effectively might fail because it lacks the necessary scientific content, or is devoid of any social and emotional context. Situations vary. In some situations, a lot of expert content can be welcomed by non-experts, including those who are comfortable participating in a risk dialogue, familiar with a risk situation and want to see its resolution. Here the expert can draw heavily on the professional facet of their *persona*. In other situations, expert content can be rejected as incomprehensible, obfuscating, irrelevant, insincere, misleading, manipulative or incorrect. When non-experts make these judgements, it can be because there are competing value and knowledge forms in play, since non-experts might consider that knowledge transparency, public health and community safety are being compromised to their detriment. In these situations, experts are required to draw more on those facets of the *persona* that allow them to express themselves as individuals, with values and beliefs, and as emotional beings who are willing to engage in lively, even hostile risk dialogue, and be capable of exhibiting empathy towards those who are worried, anxious or fearful as to risk selection or risk outcomes. Whatever the situation, experts need to select the appropriate balance between facets of their *persona*. They need to be aware of what an empirical risk implies for non-experts, and how they need to respond to their needs. Needs can be around a need for more or clearer information, for empathy, for genuine risk dialogue, or for recognition of the legitimacy of non-expert knowledge and values.

By way of conclusion, regarding the construct of *the persona of the expert*, it embodies the two modes of thinking described by Slovic et al. (2004). The experiential mode allows for ethics and morality, including personal integrity and respect for others, and is reflected in two facets of *the persona of the expert*: the expert as an individual and

the expert as an emotional being. The analytical mode allows for scientific knowledge, expert judgement and competence, and it is the expert as a professional that is in play around this mode. Finally, there are ways of thinking that draw on both modes of thinking, and it is here that the expert as a communicator applies.

The question is whether these findings about experts' mental states provide sufficient evidence to assure us that they will project a balanced *persona* when they communicate about a risk to non-experts. They might be able to, but they might choose not to, might misrepresent the risk, might remain silent or might be absent. It is here that we move from findings about experts' mental states to findings about experts' actions and consider the expert as a participant in an actual risk dialogue. In such a situation, experts need to attract the trust and confidence of non-experts regarding the credibility of their risk knowledge, their integrity and their competence to manage risk in a way that is protective of public health and safety. As we have seen above, they can do this by drawing on their *persona*, but in a material situation, more is needed than a suitable mental state. Action by experts is required, and it is here that we move to findings about *the practice of trust*.

9.4. Consolidation of findings: *The practice of trust*.

The challenges that experts are required to address are both scientific and social. In their familiar technical and commercial world, experts must address challenges associated with the selection of empirical risk and with technology designed to reduce or eliminate these risks. In the less familiar social world, the challenge is to communicate that they are competent to undertake risk-oriented activities. They need non-experts to not only trust them as people, where social or general trust applies, but to have confidence in their technical competence, as proposed by Earle and Siegrist (2006). At this point, we can consolidate findings about the relationship between trust, distrust, competence and confidence, and venture a claim regarding *the practice of trust*.

Trust is best represented as a process between experts and the non-experts when experts need to be trusted and non-experts need them to be trustworthy. Experts can practice trust when they can accept that distrust as well as trust is always present during a risk dialogue. They can practice trust when they can recognise that there is

an inevitable tension between themselves and non-experts because remediation is an industrial practice where there is, of necessity, a hierarchy around risk knowledge and technical competence.

During a risk dialogue, non-experts can apply critical trust to interpret expert risk messages, and might distrust experts as a matter of course. They could have concerns about the extent to which an empirical risk could affect them, their family or community. They would reasonably expect experts to be competent to select a risk level that is protective, and would need to see performance-based evidence as to the independence of the expert who selects the risk level. Non-experts need to be confident that experts are sufficiently independent from their clients. In this regard, experts can be aware that the integrity of the risk selection process can be compromised by commercial requirements. If experts want to be credible communicators, they need to be aware that their credibility is strongly associated with how non-experts perceive their level of independence. If experts cannot demonstrate a sufficient degree of independence from commercial interests, then non-experts could distrust them. Despite their competence around risk identification, risk assessment, risk management and risk reduction, experts might not retain the confidence of others because they cannot explain why they are competent, cannot explain the limits of their competence, or cannot demonstrate a sufficient level of independence. They might also not retain the confidence of others because although they could be effective communicators, they are not considered to be either competent or trustworthy.

Table 9.7. below provides findings taken from different chapters of this dissertation which, taken together, constitute evidence of the expert's capacity to engage in *the practice of trust*.

Summing up, to be able to practice trust, an expert must draw upon the entire *persona*. When practicing trust, the expert will address non-experts' need for competent and credible risk assessment, selection and management by drawing on the professional facet. To address the issue of independence, the expert will draw on the individual facet where values are in play, and on the professional facet, where understanding the constraints of the commercial world applies. To allow for the co-existence of trust and distrust, the expert will draw on the emotional facet where there is awareness of

‘the self’ and ‘the other’, where empathy is permitted and cooperation is encouraged. To explain risk assessment, selection and risk reduction, the expert will draw on the capacity to communicate. *The practice of trust* reflects the ideal expert, the person to whom trust can be willingly given in the expectation of their competence. However, since nothing and no-one is perfect, it is the potential of the expert that is the key. Experts are capable of *the practice of trust* in the sense that such an act is possible. As to its probability, it depends on how experts chooses to apply their *persona*.

Findings: <i>The practice of trust</i>	Ch.
A successful risk dialogue requires that both distrust and trust remain in play for its duration. A successful risk dialogue requires that trust is operationalized as an act, rather than spoken of in the abstract. Trust in experts is, in part conditional on their independence, and distrust in experts is associated with their lack of independence . Experts can understand that trust is associated with a sufficient measure of competence, professional integrity, transparency, and independence from private commercial interests. Experts can understand that distrust is associated with lack of competence, access to confidential knowledge and connections with private commercial interests. Experts can understand that confidence in them is associated with their competence.	6
Building and retaining trust requires recognition of the psycho-social and socio-political factors that are in play during social engagement. ‘Critical’ or ‘provisional’ trust are more useful constructs than ‘trust’ in situations where experts need to be trusted. Distrust can be the default position of non- experts during social engagement. Building and retaining trust involves action by the expert. If experts loose to control of a risk message, or do not cooperate with each other, they can lose the trust of others.	8

Table 9.7. Findings: The practice of trust.

At this point, we can address the first research question. It asks if there is evidence of content and processes that can bridge gaps in knowledge and understanding between experts and non-experts who participate in social engagement processes.

The synthesis of findings provided above provides sufficient evidence to warrant the following claims:

- Experts can practice trust when they utilise their entire *persona*.
- The most useful form of trust involves action that demonstrates that a person can be trusted.
- When experts practice trust, they accept that distrust is a valid position for any person participating in social engagement.

9.5. Consolidation of findings: The social literacy of experts and non-experts, and the social literacy model.

To this point, the majority of findings have been consolidated around the expert's awareness of self and situation, to *the persona of the expert*, and to *the practice of trust*. This synthesis of findings warrants the first claim, but there remain some findings that resist consolidation in these ways. To discover any use that other findings might have, I draw on Tavory and Timmermans (2014)'s and (Anderson, 2005)'s guidance about the need to resist familiarity, and to look elsewhere to position them. The question is, where to look.

In Chapter Three, I describe codes that were used in the first stage of data analysis, and now recall the value offered by the code 'social literacy'. There, I define it as a mental state that allows an individual to use their knowledge and experience as a way to understand the socio-political and psycho-social aspects of the risks posed by a techno-scientific phenomenon. In this chapter, as I consolidate all findings, I invoke the concept of social literacy with a new purpose in mind. This time it is to establish it as a frame within which to position experts' risk communication and their participation in social engagement. I do this on the grounds that both are intimately connected around the construction of the meaning of risk.

To establish social literacy as a suitable frame, I draw on the outlier findings mentioned above, and on findings about non-experts which, as yet, have also escaped consolidation.

Consolidated findings are associated with both content of a risk dialogue and the process of social engagement. Taken together, they provide evidence that experts

have capacity to understand what it takes to communicate with non-experts during social engagement, and to what it takes to participate in social engagement that is not only effective, but also fair. The question is whether the evidence is sufficient to support my claims about experts' capacities. Are the claims warranted?

Let's first consider the process of social engagement.

As we have seen immediately above, the expert can exercise *the practice of trust* but the question is whether this provides a sufficient foundation upon which to build a fair process, particularly one that has to stand the test of time. Even if the expert is trusted by non-experts, a process of social engagement can fail because the potential for conflict always exists in the material world, and cooperation, whilst sought, can be constrained by lack of fair process.

Experts and non-experts have some understanding of the process of social engagement. Non-experts can have the capacity to co-design a social engagement process, and can understand what a fair process involves. Experts can understand who their audience and identify aspects of fair process that support cooperative social engagement. Experts can know how to maintain their part of a risk dialogue so that it supports sufficient cooperation between parties regarding the need to remediate risk and deliver benefit. They can understand that a fair process cannot allow the exclusion of any person who wishes to participate, and requires inclusive communication so that no individual or group can dominate discussion by influence over others. Fair process requires the exchange of knowledge and the sharing of values. Rather than perpetuate conflict by insisting on the pre-eminence of expert risk knowledge, experts can engage in a process of co-construction of knowledge. Co-construction is a process that ensures that all stakeholder needs are met, so that everyone is immersed in the materiality of the problem to be solved.

Experts recognise that a fair process requires a Chair who facilitates positive interaction between experts and non-experts. The Chair need not be as technically qualified as other experts, but is required to be sufficiently familiar with the phenomenon of concern, the risks it may pose, and the benefits it may deliver. A Chair can support a fair process by enforcing agreed meeting protocols and arranging the provision of financial resources that support active participation by non-experts, and when required, the participation of independent advisors. These findings reflect the

intent of the integration mechanism 'fair process" which requires skilled facilitation, emphasises attention to the fine details of meeting procedure, and allows for guidelines to make clear the roles and responsibilities of experts and non-experts.

Experts can understand the concept of a social licence to operate, and can understand some key terms associated with the language of social engagement. They can understand the meaning of the terms, 'stakeholder', 'community', and 'transfer or risk'. Conversely, they can misunderstand the meaning of terms: for example experts associate 'upstream engagement' with a hierarchy of professional expertise or organisational power, rather than understand its defined meaning around the timing and intent of engagement.

Now let's consider continue the process of establishing social literacy as a suitable frame by consolidating findings about the content of a risk dialogue.

Experts can misunderstand key terms: for example, they lack understanding of 'mandated science' and 'grey literature'. Expert texts such as risk assessments or policy documents reflect 'mandated science' and commonly exist as 'grey literature'. They could be essential to a robust risk dialogue, but they might not be if those who control the dialogue consider them confidential to government or industry. If expert texts are afforded this privileged status, non-experts might become suspicious as to why and come to perceive the risk very differently to experts. Here we can appreciate why experts would need to understand the meaning of 'risk perception', and the findings show that they do. Findings also demonstrate that experts can understand that when their risk messages are released to the social world, they can become unstable in that they can be transformed by other groups and represent different interests. Another finding connects the instability of a risk message with 'the migration of meaning', which occurs when the word 'toxic' is used in a range of subject domains external to the sciences. Once this happens, experts must function in an unstable linguistic context associated with negativity.

Findings about non-experts also pertain to the content of a risk dialogue. Non-experts can understand competing knowledge forms, can apply scientific and social literacy to interpret the meaning of risk messages, and can use both the analytical and the experiential mode of thinking to process risk information. They can engage in

meaning-making about risk, and can provide an ethical frame around the meaning of risk messages.

Here, as in earlier sections we find alignment with integration mechanisms ‘balancing different knowledge forms’, ‘improved communication through language’ and ‘awareness of the mental context of risk’

Table 9.8. below provides a summary of findings taken from different chapters of this dissertation which taken together, constitute evidence to warrant the claim for the constructs of the socially literate expert and non-expert.

Summing up, an individuals’ social literacy provides them with the capacity to bridge communication gaps between themselves and others. A bridging process between experts and non-experts is in play when an individual embraces an iterative rather than a prescriptive approach to social engagement. For this inquiry, bridging content is in the form of expert knowledge, and is in play when a risk dialogue is inquisitorial rather than adversarial in nature. The individual who engages in a bridging process, or who delivers bridging content could be either an expert or a non-expert, but regarding any claims, for this inquiry they are exclusively about expert’s capacities to understand and support a bridging process and deliver bridging content.

At this point, we answer the first research question by proposing that the synthesis of findings above provides sufficient evidence of bridging process and bridging content, and warrants the following claims.

- Experts have sufficient social literacy to bridge gaps in communication between themselves and non-experts.
- Experts can engage in effective risk communication when they use their social literacy to deliver bridging content.
- Experts can engage in effective risk communication when they support, and participate in a bridging process.

To this point, they are claims that pertain to the specific context and selection of experts. They are not generalised claims about experts and their practices.

Findings: The socially literate expert and non-expert	
Findings: The socially literate expert	Ch.
Experts can identify aspects of fair process that support cooperative social engagement. Experts can understand the concept of a social license to operate. Lack of context can confound or distort the intent of a risk message. Experts can understand the nature of their target audience. Experts understand that a risk message can be transformed by other groups and represent different interests.	7
Experts understand that a fair process requires an independent chair with proven leadership qualities. Experts can understand the range of motives that can be in play during a risk dialogue. Experts vary in their capacity to correctly define key terms associated with the language of social engagement. Experts can understand the power of the internet to improve or degrade a risk dialogue	8
Findings: The socially literate non- expert	
Non-experts can provide an ethical frame around the meaning of risk messages. Non-experts can apply scientific and social literacy to interpret the meaning of risk messages. non-experts can use both the analytical and the experiential mode of thinking, and allow for interplay between them. Non-experts assign different meanings to the same object. Non-experts can apply critical or provisional trust to interpret expert risk messages.	7
Non-experts, can understand what constitutes a fair process of social engagement. Distrust can be the default position of non- experts during social engagement. Non-experts can have the capacity to co-design a social engagement process. Non-experts can understand competing knowledge forms. Non-experts can have the capacity to engage in meaning-making about risk.	8

Table 9.8. Findings: The socially literate expert and non-expert

The question then is what form of risk communication can best support a risk dialogue where the promise of cooperation is more in play than the attraction of conflict. Here, we address the second research question. It asks if existing models, frameworks and institutional guidance about social engagement offer useful ways improve the practice of risk communication. The answer is provisional.

In Chapter Eight, we find that the three models offer something, as do the two frameworks and examples of institutional guidance. They all have useful features, including their sometimes hybrid structure, but none of these features, or any degree of hybridity, are sufficient to satisfy contemporary requirement for effective risk communication about the benefits of a useful and sufficiently safe technology. This is not to infer that such a technology, when applied, will always provide for a safe situation. Experts and non-experts alike can understand that things can go wrong in any material situation, and no matter how well managed, mistakes can be made, systems can fail, and risks can be realised. However, sometimes non-experts make the impossible demand of ‘no risk’ and this confounds risk communication since in the material world, there is no such thing as absence of risk, whilst in the mental world, there can be. Hassad and Chambers (2014)’s perspective is applicable here. They write: “As the ancient Greek philosopher Epictetus said, ‘Men (or women) are disturbed not by things, but by the view that they take of them.’ Shakespeare was onto it to when he wrote, ‘there is nothing either good or bad, but thinking makes it so’” (p.86).

Taken as a whole, these findings point the way to what is needed by way of improved risk communication, and so it is at this point, that I can make my contribution to knowledge and provide a new model of risk communication.

My model anchors the expert in both the mental and material world. I name it as the social literacy model, and propose that it accommodates the warranted claims I have made about the expert’s *social literacy*, *the persona of the expert* and *the practice of trust*.

9.6. The structure of the social literacy model.

The social literacy model is founded on a demonstrated connection between theories, frameworks and guidance about risk communication and its practice in the material world.⁶⁴ The model proposes that the expert has the potential to make a difference, and assigns a critical role to the expert during social engagement when a risk dialogue is in play. Luhmann describes it as a “special task” around acknowledging that “the correct action cannot be identified in sufficient detail in advance...In this way, the problem of complexity (which infers uncertainty: [author’s clarification]) is divided up and therefore diminished...the level of uncertainty is absorbed, or made tolerable” (p.25). Here the focus is on the expert as a professional - as a person with scientific literacy. Fischhoff (1998)’s focus is on the expert as a social and emotional being who “should not function in a social vacuum, without a full understanding of the social role of their work and the opportunities to realize its potential usefulness” (p.71).

We have made warranted claims about the role of the expert that align with these perspectives. We claim that experts have the potential to communicate and thereby the potential to bridge communication gaps. What allows this potential to be actualised is the expert’s social literacy. Social literacy lies at the boundary of the mental and social world. It requires sufficient awareness of self and situation, and capacity to exercise a suitably balanced *persona*. These two conditions pertain to the mental world but social literacy demands more than a suitable frame of mind. Once the expert is present in the social world and participating in social engagement, s/he needs to exercise *the practice of trust* in order to convince non-experts that taking a risk will result in a benefit that will outweigh that risk. In sum, when functioning as a risk communicator, the expert needs to be socially as well as scientifically literate. It is only when exercising both these capacities that an expert can provide bridging content about empirical risk, and perform bridging functions during a risk dialogue. In Figure 9.3 below, I present the social literacy model.

⁶⁴ Of all the possible names I could give to my construct, the name ‘the social literacy model’ won the day. I considered other names such as ‘the co-construction model’, the ‘common ground model’, but I selected ‘the social literacy model’ as it is the most immediately descriptive of what it represents.

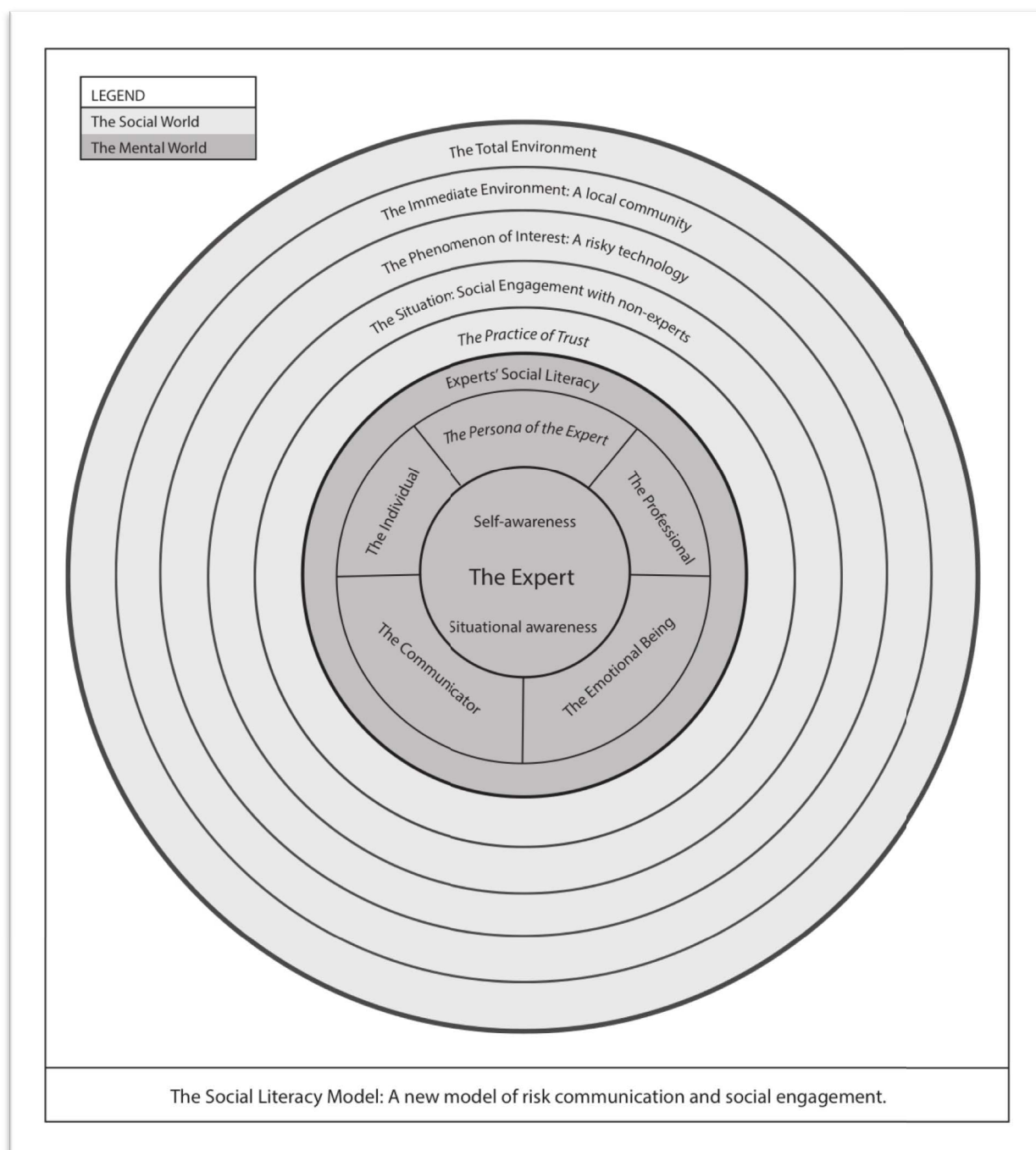


Figure 9.3. The Social Literacy Model: A new model of risk communication and social engagement.

9.7. My contribution to knowledge: A polemic on equality.

At this point, I offer the social literacy model as a contribution to knowledge. The research inquiry sought to identify ways to bridge communication gaps between experts and non-experts. During the seven years it took to complete it, I have observed that communication gaps remain evident in some areas of science, and that gaps are growing, most notably in matters associated with climate change and biodiversity protection. These domains of science, whilst highly contested are highly visible, but other areas of science receive less attention including POPs pollution risks, and population pressures on natural resources. This later is a sensitive area of social debate, including in Australia since it has become intertwined with the politically sensitive issue of migration and human rights. Gaps in communication about such matters fuel, and sometimes super-charge public debate and it could be that their continual representation in mass and social media feeds back on itself, and amplifies the gaps even more. Rather than scientific knowledge and social values framing the debates, the chatter of global social discourse reduces them to the rights of the individual to express an opinion, to be heard.

Now there is no problem with this. Everyone has a right to their own opinion. However, there is a problem if everybody's opinion about anything is given equal weight. In this sense, whilst all humans are, or should be, equal with respect to their rights, as a society we are misguided if we believe that all humans have equal capacities to undertake all things. It is a mistake to assume that equal rights infer equal capacities. It allows, as expressed in the vernacular, that 'everyone's a winner' and that children will be able to be whatever they want to be. Now that could be setting them up for disappointment or worse! They cannot, for example, become remediation experts without a good grasp of numbers and scientific concepts.

In this regard, my contribution to knowledge is the emphasis it places on the role of the expert as an individual.

My social literacy model might allow for the generalisability of the results of this inquiry. It proposes that the expert can play a socially constructive role when they understand the workings of social, as distinct from the scientific world. The mantra that students need more science, technology, engineering and maths [S.T.E.M] needs to be

balanced by one that champions values and allows a place for ethics so that people feel confident to challenge the suitability of scientific outputs when there is a need to do so. From a sustainability perspective, any scientific output that creates more pollution needs to be challenged. We have the lessons of history and current experience that tell us that the world is burdened by all sorts of pollution and that, in a sense, humans are the test animals. It is time to stop this uncontrolled experiment and heal the world, and remediation experts can play a role in this broad social objective. The question is, how good does an expert need to be to do this. An ideal expert understands the limitations of knowledge forms, recognises where values come from, acknowledges risk perception as valid, and accepts the limitations of an individual's capacity to communicate. But the world is a messy place, and an ideal expert is a rarity, or might not exist at all. What we can hope for is that experts endeavour to improve their social literacy and apply it to help make a safer, less polluted world. Maybe my model will help them see the value in doing so. If they do achieve improved public support for remediation, it will confirm the generalisability of my claim.

We can now go to the last chapter of this dissertation.

Chapter 10. Discussion, Limitations, Future Outlook and Recommendations.

In this final chapter, I share some reflections and insights about the research claims, describe the limitations of the research, explain how I envision the future, make recommendations regarding industry training, and identify opportunities for future research.

10.1. Reflections and insights.

The main claim that emerged from the inquiry is that experts can bridge communication gaps between themselves and non-experts. Their potential to do this is contingent upon their capacity to exercise social literacy. The measure of success relies on the choices experts make regarding the type of knowledge selected, and what actions they take regarding how, when and where the knowledge is communicated. Without social literacy, experts cannot communicate effectively, but this does not imply that scientific literacy is not important. Scientific literacy is the essential starting point, but risk communication, no matter how technically competent, relevant and well-delivered, might fall on deaf ears if the communicator does not possess sufficient social literacy.

Today's experts face unprecedented challenges to their authority, with contemporary media commentators claiming that expertise is dead in the mind of many. Now whilst this might well be an extravagant claim, it does reflect something of the world of social media, where experts are not always respected for their professionalism in the way they used to be. This decline of deference might exist because people are afraid of being exposed to certain substances, even if they are deemed safe when used responsibly, or because they challenge the moral basis of particular technologies, including those associated with the industrial chemical industry. One question that arises from this evolving situation is whether the internet and social media will inevitably continue to disempower experts, or whether Beck (1992)'s prescription for change around a new pedagogy of scientific rationality can come to pass. I cannot answer this question here, but I do see glimmers of hope in the current popular movement to uphold science and scientific values. However, what this inquiry

suggests is missing from contemporary scientific dialogue is sufficient consideration of social values regarding the suitability of the technologies that science produces. In this sense, science communication is not risk communication, rather it is a form of science advocacy.

Risk communication is different. Whilst it does involve discussion of scientific issues, it does not do so uncritically. Risk communication acknowledges values selection around technological risk, and the associated issue of scientific credibility regarding risk assessment and risk management. When experts communicate with non-experts, they need to acknowledge that some non-experts want a risk removed, not managed, and fail to see any benefit from taking a calculated risk, which is what experts do for a living. Total removal of contaminants is often not possible, including in post-remediation situations where contaminants remain *in situ*. Nor is it necessarily desirable, for example in a situation where, over the years, mangroves have grown in layers of clean sediment that have accumulated on top of contaminated layers. Experts might make the judgement that leaving the contaminated layers *in situ* and undisturbed poses no significant risk of harm to the local community. They might also make the judgement that allowing the mangroves to remain is to protect an existing benefit, measurable in terms of enhancement of biodiversity. The goal of the expert then, is to achieve a sufficient balance between risk and benefit by ensuring that the remediation project is well designed, fit for purpose and socially acceptable.

Remediation does not always remove contaminants completely, but it can, if undertaken correctly, address the risks they pose to a level that satisfies regulatory requirements and community expectations. Non-experts and experts alike have to live with the level of risk reduction that has been achieved. If non-experts accept this risk level, their perception of the risk will be sufficiently aligned with its empirical value. If they do not accept it, for whatever reason, their perception of the risk will not be sufficiently aligned. For example, some people, experts and non-experts alike still attach a stigma to Sydney Olympic Park at Homebush, even though the residual contamination no longer poses a significant risk. Regrettably, there is not much that tells the story of this successful remediation project on the parks' official website, as a search of the site for information about it comes up with nothing. (Sydney Olympic Park Authority, 2020). Current guidance on stakeholder engagement planning shows similar neglect of success (Institute for Sustainable Futures, 2020).

This NSW Government-funded guide provides “a case study of Homebush Bay, Olympic Park” and focusses on the need to consider the “gendered dimensions of worry when engaging with residents” (p.52). The focus on worry is over-played here, since although the *green games* social engagement process was criticised by a key stakeholder (Green Games Watch 2000, 2000), it featured aspects we have identified as constituting a fair process. It provided for ongoing engagement between experts and non-experts, and was characterised by strong, albeit critical, support by non-experts, and ongoing risk communication by experts (Homebush Bay Environment Reference Group, 1999).

At this point, I sum up my reflections and insights. I allow that it is up to experts to explain why there can be a lack of alignment between an empirical and perceived risk, and why a risk is either significant or insignificant. Whether the risk is significant or insignificant, experts have a responsibility to explain how it will be managed, but this is the hardest thing for them to do. Some have what it takes to defend a decision-making process, whilst others lack the mental acumen, position in life, or moral courage to do so. Some cannot defend a decision-making process because it does not address the risk sufficiently well, and these include experts who do not meet community expectations around independence and credibility.

One way for experts to address the conundrum posed by the existence of empirical risks is to change the way they communicate with non-experts. They can use their social as well as their scientific literacy when they engage with the public, and by this means better address the enduring uncertainty around pollution risks within the wider context of today’s risk society. They can re-invent traditional social engagement and consider non-experts as partners in a remediation process, not a group to be ‘managed’. They can enter the world of digital communications and use well-designed imagery as well as well-crafted text to explain a decision-making process. If they embrace change, they might find that it brings a new sense of purpose to their role as remediators of contaminated environments.

In this dissertation, I have endeavoured to introduce a new approach to risk communication which is anchored to the construct of social literacy in. I hope you find my argument convincing even though, of course, it has limitations. I can now tell you what they are.

10.2. Limitations.

There are a number of limitations associated with this research inquiry. It is ambitious, as allowed and encouraged by advocates of a trans-disciplinary inquiry (Lawrence & Despres, 2004; Ruppert-Winkel et al., 2015), and has an implied auto-ethnographic sub-text. By way of defence, I refer to the insight provided by Stretton (1969). As he explains, the historian's "sense of possibilities', mixed of his own practical wisdom and his knowledge.....is too complex to be reduced to rules; it is seldom wholly technical; it is affected a great deal by the historian's own interests and values. (p.26) As explained in Chapter One, my interests are around the reduction of anthropogenic pollution. They align with my values around the pre-eminence of public health protection and social justice. Because I have a professional connection with the remediation industry, there was potential for the presence of the researcher effect (Chenail, 1997), and during the inquiry, I often reflected on my position as a researcher.

A risk of the researcher effect was evident during the in-depth interviews. I had a relationship with some interviewees, in that we came from the same industry and sometimes shared experience with POPs remediation projects. Experts might have answered questions in a particular way in order to assist my research inquiry, and to address this risk, I took Chenail (1997)'s advice that does allow for closeness provided that the researcher adopts a particular awareness to mitigate methodological risks. During the in-depth interviews, I managed the risk of the researcher effect by being conscious not to stray beyond the questions contained in the interview *pro forma*, and avoiding small talk and familiarity. During interview, I may have occasionally influenced the interviewees' response by making a clarification or suggesting something to them.

The risk of confirmation bias was also in play during in-depth interviews, since the intent of the questions could not, as Tavory and Timmermans (2014) allow, to avoid the presence of pre-emptive meaning embodied within them. (p.40) To avoid the risk of confirmation bias in the framing of the interview questions, I drew on Stretton (1969)'s argument that an individual can be objective provided they acknowledge their epistemological position. To address the risk, I applied a consciously reflexive process

when developing the interview *pro forma* and undertook a pilot survey to test its suitability. A few changes were made but none were substantial.

The in-depth interview process itself was not without flaws. On several occasions early in the interview process, I did not ask the interviewee the *pro forma* interview questions on types of values and corporate responsibility, as they were not worded as clearly as they might have been. I reflected on how to resolve this situation before I undertook more interviews. I decided not to make any adjustments to these questions, as any change could have compromised comparability and consistency, as well as fairness to all interviewees in that they were all asked the same questions. This decision did not prevent me from asking different interviewees additional questions as the opportunity arose.

There were limitations around the selection of literature for the literature review. I confined it to what was manageable and selected literature that was representative, rather than comprehensive in scope. I aimed to identify key issues and themes associated with the topic of inquiry as expressed across three broad disciplines: the bio-physical sciences, the humanities, and the social sciences.

'Humanities literature' included literature created by NGOs, individuals and institutions that reveals something about Australian social responses to pollution risks over a number of years. Much of it is retained in private libraries, or stacked up in under-resourced environment organisations where it is not readily available for the purposes of research. By selecting some of this literature, I was able to bring it to light, and use it to draw attention to the wider context of society's experience of pollution impacts. Regarding public interest science books, I selected works that made an impact on public consciousness about pollution impacts that I had collected over the years. My experience as a community campaigner is evident here. Regarding the philosophical literature, I focussed strongly on the work of Luhmann (1979) and Beck (1992), neglecting work that followed it such as Beck et al. (1994).

Regarding literature from the bio-physical sciences, any selection could not claim to be comprehensive, as the POPs knowledge domain is vast and always expanding. My selection of peer-reviewed scientific literature reflects my interest in POPs, their global distribution and their health impacts, particularly on the young adults, children and the unborn. Here my humanist perspective is evident, since it is my belief that

anthropogenic pollution will continue, as it has done in the past, to contribute significantly to the burden of disease, disability, and reproductive malfunction and disorientation. Regarding literature about POPs created by public institutions, I selected Australian and international reports that reflected changing approaches to the management of POPs risks. One cannot follow them all, and I neglected some, including the new sustainable remediation standard for soil quality (International Standards Association, 2017), and current thinking on the future of European Union regulation of PFAS (Bertato, 2020).

Regarding literature from the social sciences, there is a vast range of theory and research from which to choose. I reviewed literature from a variety of domains, including risk communication, and the psychology and the public understanding of science. My preference was for risk communication, rather than science or environmental communication literature since it is fully aligned with the research topic. The other attraction of risk communication literature is the focus on competing models of risk communication and social engagement, topics which are absent from science or environmental communication literature.

Limitations were around the methodology. Social sciences allow for a range of methods, including in quantitative research where large-scale surveys generate data. This method requires a minimum sample size to support the generalisability of claims. They are scientific in-so-far as they use statistical methods of analysis, but not necessarily regarding the way the survey questions are created. In qualitative research, a wide range of methods are allowed (Frost et al., 2010), including those where a mix of quantitative and qualitative research is used to generate findings that support claims. Published research identifies various types of mixed methods (Johnson & Onwuegbuzie, 2004; Johnson et al., 2007; Teddlie & Yu, 2007), including research using a small sample size. In qualitative research, there is nothing that disallows a small sample size, provided the researcher is aware of the limitations around generalizability. Stretton (1969) defends its use, as do other researchers, including Miles et al. (2014) and Teddlie and Yu (2007). The latter point to the value of small sample size provided it is selected using a suitable purposive sampling technique. As explained in Chapter Three, Section 5.1., I used purposive sampling when I selected the seventeen experts for research and interviewed them in-depth for between ninety and one hundred and twenty minutes. Although on a smaller end of a

non-statistical sample, there is compensation in that they were longer than those used by other researchers, including for example, Santos and Chess (2003) who undertook twenty in-person interviews, each lasting between sixty and ninety minutes, and Scheer et al. (2014) who did phone interviews with twenty-six experts, each lasting sixty minutes. Another group of researchers conducted thirty-two interviews of the same length (Reed et al., 2009). Driedger (2008) undertook a total of 18 interviews averaging approximately 90 minutes each. Here we see variation between 18 to 35 units in a number of small samples, and I propose that at seventeen, my sample size is sufficient to support a qualitative inquiry via in-depth interview.

In-depth interviews were one of six tools of inquiry used to generate data about experts. By generating strands of evidence from each, I built an argument to explain why and how experts can bridge communication gaps between themselves and non-experts. I did not seek representation, rather sought to understand why such gaps exist, and how they might be resolved. As explained in Chapter Three, Section 3, I used abduction as the mode of inference to build the argument and establish claims.

As to other limitations, regarding the questionnaires, there is a limitation around the low response rate, with twelve of the seventeen experts completing them.

Regarding the Key Terms Questionnaire, I made a less than optimal choice when I included the terms 'No Effect Level' and 'Kinetics'. 'No Effect Level' is mentioned in POPs science literature, but has been superseded by the more precise term, 'No Observable Effect Level' which is routinely used in health risk assessment and is familiar to experts. 'Kinetics' refers the way in which contaminants move around the body and is also used during health risk assessment. It is not a term commonly used by remediation experts, which probably explains why no expert understood it sufficiently well. I did not include responses from these two terms in the analysis.

The design of the Milestones Questionnaire was limited by the presumption that respondents were familiar with the milestones. They might not have been, and it is possible that they did not understand how to respond. A better way would have been first, to ask if the respondent was familiar with each milestone, and then to ask if the milestones were relevant.

To sum up, regarding limitations of my inquiry, findings and claims can only ever be provisional, not conclusive, including findings from qualitative research. As we understand from the null hypothesis, it is only possible to disprove a negative, rather than conclusively prove a positive. In other words, truth is contingent truth in the sense that it is contingent upon falsifiability.

Now we can look at the future of risk communication.

10.3. Future outlook. A polemic on risk communication from a humanist's perspective.

Here, I envision what risk communication could look like in the future, and how experts might be able to communicate sufficiently well to both protect and advance their industry, and still retain a moral commitment to society by supporting robust public health protection.

In the future, there probably won't be a lack of business opportunities, as the demand for the rehabilitation of degraded natural capital will only increase in future years (Pachon, 2013). Whilst not all contamination is associated with POPs, the industry's experience with these recalcitrant compounds renders experts fit for purpose in the future risk society, where increasing pollution of the environment appears to be inevitable. So will clarity of communication help, as proposed by a leading business group (Hepworth, 2016)? It probably will, but we cannot escape the reality of shifting public values and the challenge this poses to communication about technology risks. As society becomes increasingly reliant on technologies, the value of the capital provided by the natural environment might fade from public consciousness and the benefit of protecting it become less important. Beck (2016) argues this when he proposes that humans have become de-coupled from their natural biology by technologies that they themselves have created. He explains this in his earlier book as "anthropological shock" which "induces a kind of compulsive collective memory of the fact that past decisions and mistakes are contained in what we find ourselves exposed to" (Beck, 1992 p.123). Here, Beck anticipates the idea of living in the Anthropocene (Stromberg, 2018). Given this, we could anticipate that people might find refuge not so much in social institutions or experts, but in personal outrage about the assault on their rights as individuals not to be poisoned, spied upon, or socially or ecologically compromised.

It is reasonable to assume that in the current era, values have shifted and there is a lot of competition around rights. Who can claim them? The natural environment cannot speak for itself in parliament or in the courts. The natural environment must rely on humans to defend its integrity. Other voices crowd these spaces, loudly championing individual rights, and in Australia today, this focus on the human as an individual with exclusive rights is pushing aside a more community-based understanding of human rights, where traditional values around a broad-based concept of justice, including environmental justice and 'a fair go' find it hard to compete.

So what could make a difference and amplify the voices of experts? Science lobbyists and public figures speak of the need to connect lay people with scientists and their research, but they might be following a modern version of the deficit model of risk communication. Just make people understand science and then they will agree with us and support our research which of course, is in society's best interests! But is it? The outputs of modern science can be useful, but they have significant downsides. New industrial chemicals make life easier or cheaper, but contain hazardous chemicals that are finding their way into the cord blood of newborn babies. These and other exposure pathways are affecting sexual orientation and reproductive capacity, (Colborn & Clement, 1992; Colborn et al., 1996; Myers, 2012), or creating subtle neurological impacts (Lanphear et al., 2005; Ovokeroye et al., 2014). Regrettably, public discussion about these risks to future generations appears to be largely absent.

So what's missing from discussions about technology risks? From my perspective, it is values associated with connection to nature and what the natural environment provides for human society. The question is whether, if experts become more socially literate, they will be better prepared to discuss the values inherent in their professional roles. Remediation experts are well placed to do this because their role is to heal contaminated environments by reducing pollution, delivering rehabilitated ecosystems and promoting urban renewal. In this sense, they hold a unique position as professionals who can deliver benefit as well as create and manage risk. There seems to be no significant, enduring downsides to what these experts are tasked to do, but there are limits imposed by the individual's situation in life. In my inquiry I have provided evidence that not all experts exhibit high moral values, nor exercise what Aven (2007) refers to as the ethics of the mind. After all, experts have to make their

way in a world where developers, with their money and power wield political influence. Given this reality, experts might need to exercise the ethics of consequences.

Maybe experts need to focus on achieving better quality mandatory science, and so lessen the stranglehold that our risk-focused society has on policy and decision-making. Experts could improve their defense of credible risk-based decisions and demonstrate that they are needed from an environmental and social perspective. In this future scenario, the needs of the physical environment and society as a whole would be put first in all decisions, regardless of their impact of private commercial interests, or the career interests of politicians when an evidence-based decision about a negligible contamination risk might adversely affect their public image. This situation can occur in N.S.W., due to a provision of the Protection of the Environment Operations Act 1997. It stipulates that “the occupier of a premise at which scheduled activities are carried on under the authority conferred by the licence must not cause or permit the emission of any offensive odour from the premises to which the licence applies (Land and Environment Court New South Wales, 2019, Section 129. Underlining added).

This provision illustrates the problems of governance in a society organised around risk. What makes an odour offensive and hence unacceptable to some, could be acceptable to others because it is a necessary part of a remediation project which they want and approve of. Even if the odour is unpleasant, even offensive, they find it acceptable because it is connected with future benefit in terms of remediated lands and the promise of urban renewal. In this regard, laws and policies might look good on paper, and politicians might look good when they signal the virtues of zero risk, but in practice, it is impossible to achieve, and calling it up in legislation could lead to unexpected consequences around excessive risk governance of remediation and misleading risk communication. Given this, it is important to recognise that the risk society has, as Beck predicted, come to fruition. What happens next is an open question, but as with all things human, improving understanding is always useful, so let's go now and consider what this inquiry yielded about industry training needs.

10.4. Recommendations for industry training.

Within the remediation industry in Australia, a strong emphasis is placed on continuing education (ALGA Ltd, 2017). One focus is on improving professional competency and experts interviewed for this inquiry identify training needs around the use of statistics, understanding problem definition, the integration of different areas of knowledge, and the understanding of scientific principles. They recommend more formal training at tertiary institutions, and informal industry-based training that utilises the knowledge, experience and understanding that comes from professional practice.

One training area yet to be realised is improving understanding of the regulatory framework, including understanding of issues associated with due diligence, evidence, compliance and legal professional privilege. This latter is particularly important since it allows risk information to remain hidden from regulators and the public on the grounds of commercial confidentiality. It is possible that the very existence of legal professional privilege could contribute to public distrust, not only in developers and their legal counsel, but in government institutions and the remediation industry as well. In this regard, there could be benefit around a better understanding of the interface between science and the law. The idea sits well with the idea of social literacy and at this point, I provide my own recommendations about how experts might be trained to better understand and exhibit it.

Experts might improve their social literacy if they had some understanding about different models of risk communication. With improved understanding, experts might be able to see why the delivering of risk content using a deficit model approach is counter-productive as a form of risk communication. They might come to understand the limitations of dialogue models where process is privileged over content, and knowledge contestation remains adversarial rather than inquisitorial. Improved understanding of mental models could support more effective communication by acknowledgement of the legitimacy of differing risk perception, and alert experts to the perils of focussing on the individual, rather than on what the individual needs in terms of certainty about the selection of empirical risk levels.

Training in social literacy could contribute to improved information delivery, particularly through the use of visual and experiential techniques of communication. If used

correctly, imagery can enhance risk communication, if not, it can undermine it. If organised carefully, experience of the materiality of remediation can enhance the public understanding a risky technology. If care is not taken when non-experts visit a remediation site, they can easily get the wrong impression.

Also important is improving media training so that experts can better understand how to engage with mass and social media where competing knowledge forms are in play. Well-targeted media training could improve confidence regarding the defence of their own knowledge forms, since experts need to better communicate that their industry exists to help heal the earth. They can do this if they change the symbolism around risk and create a more credible dialogue about risk and benefit.

Given this, experts need to understand first and foremost, that both mass and social media can function as friend or foe, and then be willing to be trained to take advantage of what is on offer. In this sense, digital media needs to be used as an engine for risk communication, not suffered as an engine of risk amplification. Whilst experts should not sugar-coat remediation risks, they do need to be capable of explaining the uncertainty paradox. To do this, an expert will need to have a sufficient capacity for spoken language, and here they need to acquire or refresh basic language skills. They need to understand why the use of certain words can limit their capacity to communicate with non-experts. The phrase ‘capture the community feeling’ might sound reasonable, but from another perspective, it might sound manipulative. After all, why would people want their feelings to be captured? They might prefer that their feelings are acknowledged and formally recorded. And what about the term, ‘sensitive receptor’? If you realise that it is you who is a sensitive receptor, you might become alarmed or offended that another person might consider you in such an impersonal way.

Another area of language training is about the variable function of verbs. Of particular importance is the use of verbs that add depth and meaning to an explanation, including those about risk. A risk can, might, could or will eventuate, and in a risk dialogue, experts must be able to make these distinctions clearly. As explained in Chapter Nine, distinctions rely on whether there is the probability of a risk being realised (could happen), or whether there is the possibility of the same (might happen). This skill is

critical to communication about the meaning of an empirical risk. The two findings of Chapter Seven, Section 2.3. are instructive, and I repeat them here:

Firstly, experts can acknowledge that science can never provide conclusive evidence of safety.

Secondly, when experts use verbs that convey an obligation or compulsion to act, they can acknowledge uncertainty and provide for certainty.

Good quality training can draw on credible professional knowledge, but it can remain underutilised because experts and trainers might not appreciate its value, lack the time needed to utilise it, or do not know much about it. Lack of knowledge about a landmark remediation project in NSW was anticipated by civil engineer John Pym when he wrote his comprehensive report about the remediation of degraded and contaminated land and the subsequent creation of Sydney Olympic Park (Pym & Sydney Olympic Park Authority, 2001). His *green games* information legacy is invisible on the Park's official web-site (Sydney Olympic Park Authority, 2020) and recognition of this expert's contribution is not reflected in the upkeep of his commemorative plaque, or associated way-finder, as you can see in Figure 10.1 below. The blank area originally contained a complex image depicting the cross section of a remediated landfill at Sydney Olympic Park called Woo-la-ra. It showed all remediation layers, including encapsulated industrial wastes and leachate drains (Olympic Coordination Authority, 2000). This landfill is directly opposite extensive new urban development, which might or might not, explain the absence of information about remediation of contaminated land on the way-finder.

We can now move the final part of the dissertation, where I identify opportunities for future research.



Figure 10.1. Tribute to John Pym, Civil Engineer. Top left: plaque at the base of a way-finder at North Newington, Sydney Olympic Park. Top right image: the blank area on the way finder. Photos taken in 2019. Source. Author's image library. Australian Securities and Investments Commission (2018). Bottom image: John Pym. Source. Courtesy Mrs B. Pym.

10.5. Opportunities for future research.

Scientific and social research might become more relevant to the world if researchers undertake rigorous empirical inquiry using a trans-disciplinary approach. Beck (1992) wants “*respectable research*” that is supported by an “*institutionally strengthened and protected moral and political backbone*” that allows “taboo zones inspired by political sensibilities” to be broken, allowing experts to assert the primacy of knowledge” (p.82, original italics).

In this way, Beck wants science to reclaim its credibility and make a new future for itself for the good of society, to find “new fields of activity and application” by allowing *the publicly transmitted criticism of the previous development (to) become... the motor of expansion* (pp. 160-161, original italics). Here Beck echoes Luhmann’s proposal about the dynamic relationship between trust and distrust. Beck urges the incorporation of values into environmental decision-making through a re-imagined partnership between scientists and the public, what he describes as “*switch settings for alternative social futures*” (p.179, original italics). Here he expresses optimism in that “(t)he hope remains that reason, which was silenced in science, can be activated and mobilized against it. Science *can change itself* and revive enlightenment theoretically and practically through critique of its own historic self-conception” (p.180. original italics).

Change is one thing, communicating that there has been change is another. As my dissertation has shown, improved risk communication is one way to do this. Future research that focusses on identifying how experts can improve risk communication is best undertaken through empirical inquiry, including into experts’ use of visual and experiential communication techniques, their use of language and their presentation of risk knowledge. Empirical research could assess the applicability of the social literacy model of risk communication.

What is a given in the social world is that people will always disagree about what constitutes an unacceptable risk. What is neglected is the possibility that people will support the process of reducing risk. In this sense, a useful focus would be getting a result that is beneficial to everyone: in other words, to work cooperatively to reduce the impact of what are inevitably risky situations. There are records of recent and

current remediation projects, and the experts and non-experts who participated, or participate in them are alive and have stories to tell, experiences to explain and knowledge to share. There is plenty of scope here for research that explores the applicability of the social literacy model and I offer it for consideration.

Thank you for your patience in reading my dissertation.

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Appendix 2.1. Criteria for selection of time periods.

The time periods are:

- 1961 to 1978
- 1980 to 1995
- 1996 to 2013

The selection method used to establish the three time periods.

The first time period was the decade 1961-1978 and was established on the basis of my knowledge, understanding and experience of POPs pollution risks, events and processes, and the public dialogue and institutional responses about these phenomena. The second time period was established by a consideration of the impact of changes in communication technology over time, including the emergence of mass media technology, such as colour television, the availability of low-cost magazines, and cheaper, accessible electronic communication made possible by the arrival of the internet around 1994. The third time period was established on the basis of my knowledge of scientific and institutional responses to pollution risk.

Brief descriptor of the three time periods

The first period began with the publication of 'Silent Spring' (Carson, 1963), a public interest science book accredited with starting the modern environmental movement (Jameson, 2012; Kroll, 2001). It ends in 1978, the year that the U.S. Government declared a Federal Health Emergency at Love Canal in New York State, U.S.A. due to community exposure to dioxins, and when the N.S.W. Government in Australia instigated fishing bans in Sydney Harbour and its tributaries due to dioxin contamination of fish.

The second period begins in 1980, a decade when global awareness of, and scientific knowledge about, pollution began to mature to a point where governments were obliged to enact laws to protect human health. It ends in 1995, the year that the Australian Government enforced total ban on a number of POPs insecticides, when the Master Plan for the development of Homebush Olympic site was released and when there was full public access to the internet via Netscape.

The third period begins in 1996 with the publication of “Our Stolen Future” (Colborn et al., 1996), a book which provided evidence about the impact of POPs on the endocrine system, something brought to public attention by Carson (1963) over three decades before. It ends in 2013, the year that the Australian Government introduces an amended National Environment Protection Measure (NEPM) about contaminated site assessment (Commonwealth of Australia, 2013b).

Carson, R. 1963. *Silent Spring*, London., H. Hamilton.

Colbourne, T., Dumanoski, D. & Myers, J. P. 1996. *Our Stolen Future*, Dutton Signet/Penguin.

Commonwealth of Australia 2013. Guideline on Community Engagement and Risk Communication. *Federal Register of Legislative Instruments F2013C00288*. Canberra: Commonwealth of Australia.

Jameson, C. M. 2012. *Silent Spring Revisited*, London, Bloomsberry.

Kroll, G. 2001. The “silent springs” of Rachel Carson: Mass media and the origins of modern environmental-ism. *Public Understanding of Science* 10, 403-420.

Appendix 2.2. Social Science Literature: Theories, models and frameworks.

Appendix 2.2. provides the full range of social sciences literature that was reviewed during the course of the research inquiry. It also provides more detail from texts of particular relevance to this research inquiry.

“Risk communication is a dynamic field, both an art and increasingly a science, and a great deal more theoretical and empirical work is required before our comfort level increases” Greenberg et al. (2012 p.777).

Social theorists have researched risk communication between experts and non-experts for over thirty years (Beck, 1992; Bickerstaff, 2004; Flynn & Bellaby, 2007; Greenberg et al., 2012; Gregory et al., 2006; Gupta et al., 2012; Gurabardhi et al., 2004; Kasperson et al., 1992; Kasperson et al., 1998; Leiss, 1996; Renn, 2006; Sandman, 2012; Slovic et al., 2004; Slovic et al., 2001; Wardman, 2008). They propose that different epistemic communities create risk knowledge on their own terms, and argue that this is the reason why risk communication between communities can fail. They investigate the failure by exploring phenomena including contested knowledge forms and the production of meaning, as well as social engagement, agency, values, trust, uncertainty, experience and perception (Cvetkovich et al., 2002; Earle & Siegrist, 2006; Keller et al., 2006; Petts, 2008).

Trust is a major focus of risk research (Bostrom et al., 1994; Cvetkovich et al., 2002; Earle & Cvetkovich, 1995; Earle & Siegrist, 2006; Keller et al., 2006; Petts, 2008; Siegrist et al., 2007), (Earle et al., 2007) and there are plenty of trust determinants proposed White and Eiser (2007). Researchers use other terms as well as “determinants”, including terms such as measures (Naef & Schupp, 2009), or variables, aspects and factors (Eiser, Stafford, Henneneberry, et al., 2009; Pidgeon et al., 2007; Trettin & Musham, 2000). Effectively, they mean the same thing. Petts (2008) points to sixteen definitions, noting the “fuzziness which surrounds trust” (p. 823), and Visschers et al. (2008) report a number of studies that indicate that it’s importance may be over-rated (p.160), and note a lack of “consensus on the specific functions of trust or the determinants of trust” (p.160). Gupta et al. (2012) identify

trust as one of thirty-one determinants that influence decision-making about the acceptability of new technologies with the most frequently nominated being perceived risk, followed by trust.

Values are also a focus of risk research (Aven, 2007; Baron & Spranca, 1997; Bohnenblust & Slovic, 1998; Cross, 1998; R Gregory et al., 2001) as is uncertainty (Auyero & Swistun, 2008; Aven, 2007; Bammer et al., 2008; Boholm, 2008; Goodin, 1978); Tversky and Kahneman (1974); (Van Asselt & Vos, 2008).

Aven (2007)'s approach is instructive. He discusses risk setting in the face of uncertainty, proposing that those charged with setting a risk level need to understand two ethical states: the ethics of the mind where morality is in play, and the ethics of consequences when utility is dominant. There is a tension between them with respect whose values will determine the risk level. In social engagement situations, if there is not enough knowledge about the risks of a technology, values function as a mediator between different epistemic communities. However, relying solely on values to determine a risk is, as Aven (2007) argues, not sufficient, and this is where trust in experts' knowledge comes into play. In this sense, trust is an act, a form of behaviour, the action of placing trust, and it can take time.

Sometimes distrust is a subject of research (Groothius & Miller, 1997; Trettin & Musham, 2000) as is the influence of mass and social media (Bryant & Oliver, 2009; MacNamara, 2014; Scheufele & Tekesbury, 2007; Witthoft & Rubin, 2013).

Researchers propose theories of risk communication based on epistemic positions that range from strongly realist or positivist, through to critical realist and strongly constructivist (Botterill & Mazur, 2004; Flynn & Bellaby, 2007; Moon & Blackman, 2014)

The realist schools tend to emphasise scientific content and information, the constructionists prefer engagement and interaction, and somewhere in the middle are those interested in the role of the individual, their perception and experience. There are variations within theories and their borders are not always rigidly defined (Irwin, 2007; Vandermoere, 2008; Wardman, 2008). All have limitations. Psycho-social models can over-emphasise the individual and focus too much on risk perception (Ropeik, 2011), whilst positivist, realist or "rationality-driven" approaches tend to

ignore the social dimensions of risk and thereby fail to communicate with people who could, or will experience it. Wallace (2011) understands this when she calls for toxicologists “to get our message across” and close the gap in understanding between experts and “the man in the street” (Wallace, 2011 p. 8). She argues that “the message we need to communicate is that toxicology can rationally and logically assess risk and provide vital guidance.... we must improve the ways in which we explain our subject to the general public...Until we scientists learn how to do this effectively (every time) the gap between applied toxicology and the affective/emotional/ instinctive processing...will continue to exist and toxicologists will continue to be viewed by the general public with an air of suspicion” (Wallace, 2011 p.8).

Later in this dissertation, I explain why scientists and other experts might not find it so easy to learn how to communicate effectively, but at this point let’s see what limits there might be around the constructionist approach.

Horlick-Jones (2007) notes, and rejects the tendency of some strongly constructionist scholars to conceptualise risk as being “all in the mind”, urging a focus on real-world settings (p.41). Irwin (2007) agrees and proposes that a solution to the problem of academic relevance lies in a co-construction process which accommodates both empirically-based and psycho-metric approaches to risk communication. Vandermoere (2008) concurs when he finds that risk research has become too hypothetical and proposes an “ecological-symbolic approach” to risk communication modelling (p. 387).

Researchers also propose models of risk communication and distinguish between three overarching models. Each model is grounded in different epistemic settings, ranging from strongly realist or positivist for the deficit model, through to critical realist and strongly constructionist for the mental and dialogue models respectively. There are various iterations of each model, with emphasis placed on different phenomena and processes, including knowledge forms and the production of meaning, the social relationships around equity, transparency, power and values, and mental states around cognition, perception and heuristics. As with all theoretical constructs, their boundaries are not necessarily fixed. See for example Gregory et al. (2006), Scheufele and Tekesbury (2007), Laird (1989), Heath (2005), Evans and Plows (2007), Boholm (2008), Atman et al. (1994), P. Brown (2009), Ropiek (2011), Hamilton

et al. (2006) and (Wardman, 2008).

Deficit models lie in the realist area of the epistemic spectrum and propose that the effective communication of scientific knowledge is the way to resolve conflict about risk selection. Mental models lie between critical realism and co-constructionism, and rely on psychological processes associated with perception, experience and behaviour to explain the variety in the way people conceptualise empirical risks. Dialogue models lie more toward the constructionist end of the spectrum and focus on social processes, inter-group dialogue and power relations as ways to understand risk and build consensus around risk selection.

Deficit models of risk communication

“The public...only need to be stuffed full of technical details, and then they will be able to share the experts’ viewpoints and assessment of the technical manageability of risks, and thus their lack of risk. Protests, fears, criticism, or resistance in the public sphere are a *pure problem of information*. If the public knew what technical people know, they would be put at ease-otherwise they are just hopelessly irrational” Beck (1992 p.58. Original emphasis).

Deficit models afford scientists a privileged position in risk communication and presume that they are trustworthy and competent. They preference scientific knowledge over all other knowledge forms, including tacit, cultural or local knowledge and are defended on the grounds that scientific knowledge is the only knowledge form that can explain the meaning of empirical risk. They place science and scientists at the centre of a risk dialogue in order to reduce gaps in non-experts’ understanding about risk. As S. Owens (2000) puts it, “the public must be engaged in order to be better informed and converted to a ‘more objective’ view” (p.1141).

Deficit models propose that scientific knowledge about risks is necessarily dominant because it supports improved understanding, and by implication, more acceptance of risks by non-experts. In this type of risk dialogue, the role of the expert is to reduce non-experts’ knowledge deficit about involuntary risks so that there is less conflict about them, which can delay or prevent their acceptance. Non-experts can ask questions about scientific issues, but not to question the integrity or veracity of the science itself. (Leiss, 1996; National Academies of Science Engineering and

Medicine, 2017; Ropeik, 2011). S. Owens (2000) contends that deficit models voice “the lament...that lay people are ignorant of environmental science and irrational in their response to risks” (p. 1141).

Examples of the application of the deficit model approach can be found in the U.K (The Royal Society, 1986; Wallace, 2011), the USA (Franke & Franke, 1975; Nürnberg, 1985), and in Australia (Selinger, 1989/1998). Selinger’s book explains the chemistry that underpins consumer products to a wide audience, and the fact that it has been in print since its publication suggests that people recognise that they might have a knowledge deficit and want to reduce it by a better understanding of scientific information. So why then is knowledge deficit a problem when there is so much science communication in play to fill the gap? It can be when the stakes are high, say around public acceptance of new, unfamiliar technologies that appear to be potentially risky. When communication about them falters or fails, the deficit model assumes that this is the result of poor quality or poorly selected scientific content, experts’ delivery of insufficient or excess scientific content, and lack of scientific literacy on the part of the public.

Deficit models are also referred to as the realist or foundationalist approach (Irwin, 2007; Vandermoere, 2008), and expressed colloquially, they are known as the ‘decide and defend’ or ‘hard science’ models. Variations include risk message and risk dialogue models (Wardman, 2008), the realist or foundationalist approach (Flynn & Bellaby, 2007; Vandermoere, 2008), the ‘science-based’ model, or the ‘science literacy model’ (Prior, 2013).

Research about improving deficit models focuses on making science content both more understandable and more accessible. Contemporary versions provide scientists with approaches and techniques that can improve their communication with the public, involving, for example, techniques to improve content delivery, and approaches that support more inclusive engagement processes, as well as encouraging attention to the values and expectations of lay people (Greenberg et al., 2012; National Academies of Science Engineering and Medicine, 2017; Ropeik, 2011). Contemporary thinking within the science communication community reflects this approach. Today’s science communicator aims to enhance public confidence in science and its positive message of progress and achievement. (Australian Science Communicators, 2019)

This all sounds reasonable and sensible. However, there is a problem with the implicit assumption that a particular risk is scientifically defensible, always manageable and therefore socially acceptable, provided that people have enough information provided in a suitable setting. What is missing is consideration of competing values. If people have firmly held values, for example about health protection, then they might reject what is scientifically considered an acceptable risk for reasons other than its empirical characteristics. As R. Gregory et al. (2001) find, when people hold rigid philosophical positions about technological development and oppose it, those who deploy a deficit model approach to communicate with them will probably fail, even if the empirical risk is insignificant. The idea of acceptable risk is just not relevant to such people on philosophical grounds. In this sense, criticism of deficit models reject their basic premise that preferences expert knowledge over other knowledge forms and propose that they cannot resolve conflict about risks (Brownson et al., 2009; Healy, 2009; Vandermoere, 2008).

From this perspective, it could be argued that the model reflects a naïve, even elitist approach. It assumes that filling the knowledge deficit will reduce the likelihood of public antipathy to a risk situation, event or process, even if it is unacceptable to people, for example, because of the values they hold, or experiences they have had. In this respect, criticism is based on how facts are selected, or not selected, for communication purposes. As Fischhoff (1998) explains: “it is hard to know why particular facts were chosen for risk communications...their selection may seem arbitrary. Commonly known facts may be repeated, while potentially useful ones are presented without necessary context” (Fischhoff, 1998 p. 66). Eiser, Stafford, Henneberry, et al. (2009) account for this situation by referring to “the relationships between experts and the public” (p. 289) and S. Owens (2000)’s concurs, pointing directly to the power relations inherent in the dialogue model. She argues that those who adopt it are motivated by the need to legitimate a decision that has already been made and that “the aim is passivity”. (p.1141) Scheer et al. (2014) might agree since they identify a *control* problem around knowledge selection, whereby those with responsibility for a risk select risk levels, and decide the level of risk acceptability and extent of liability. In this schema, experts might, as Trettin and Musham (2000) observes, lack the motivation to explain the actual level of risk due to self-interest.

Another line of criticism draws on the processing of risk knowledge by the individual.

Bergmans (2008) rejects any approach that interprets risk as a statistical 'fact', and proposes that "treating differences in risk perception as a rationality deficit between 'true' and 'perceived' risk, is not adding value" (p.180) Here, the meaning of a risk is positioned from an individual rather than a scientific perspective, as in Gregory et al. (2006)' schema which allows that when risk knowledge is provided by one person to another, it will be processed both analytically and experientially, regardless of its provenance. Here, it is the perception of risk that confounds the effectiveness of deficit models, regardless of the extent or timeliness of information flow that they can provide.

Poortinga and Pidgeon (2003) find that individuals cannot be persuaded by expert knowledge, and that if information is over-emphasised, people might think that their concerns are not being taken seriously. These perspectives suggest that deficit models, no matter how well applied to a given situation, may undermine public confidence in science and trust in scientists. So can deficit models be improved or should they be abandoned? Gregory et al. (2006 p.397) reject their basic premise about the need "to retrain the lay public", preferring "more deliberative methods that can cope with the principles of sustainability and the limits of expert knowledge". They also find that deficit models are still the preferred models used by institutions during social engagement.

Now whilst there are legitimate grounds for criticism of deficit models, they can be too rigidly characterised. For example, early proponents of scientific risk communication sometimes exhibit a broader perspective than one driven by facts alone, as this statement from the editor-in-chief of a science publication reveals:

"It is becoming increasingly clear that the assessment of the environmental impact of man's endeavours must be made as rapidly and painlessly as possible...while panic and hysteria serve no useful long-term purpose, but in fact boomerang and disenchant the public...nevertheless it is incumbent on man to safeguard our planet" Lee (1976 from the Preface)

Here we see an example of a scientist invoking a moral position with respect to technology risks. As Pollard et al. (2004) finds, it is not uncommon for scientists to go beyond the boundaries of their knowledge domain in order to present science "in a full human context" (p.3)

At this point, it is worth noting that proponents of the deficit model exhibit some understanding of the psycho-social and socio-political context of technology risks and why they must be considered (Pollard et al., 2004; Reckelhoff-Dangel & Petersen, 2007; US EPA, 1988, 2017; US National Research Council, 1994). For example, the U.S. Government amended Superfund laws mandated the concept of ‘community right to know’ and facilitate public participation about the investigation and remediation of Superfund sites ¹ (United States Government, 1986). In that era, understanding the risks was challenging and underestimating them was common, as Eiser, Stafford, Henneberry, et al. (2009) and Pezzullo (2007) show when they explore community experiences of site contamination.

So if science-based models do have a place, what is the current thinking about their value? Institutions opt for improved versions around social inclusiveness (National Academies of Science, 2017), but S. Brown (2009)’s proposes a new way to ‘fix’ the information deficit, this time in reverse. He argues that the information deficit belongs to the expert who has to “live with, and manage, uncertainty and lack of knowledge” (p.609).

Brown considers that the endless scientific research into uncertainties leads to weak decision making, and rather than continue to allow “paralysis by analysis’ (p. 609) , he wants attention to decision-making that is inclusive, supports transparency of information and considers ethics and values. His new deficit model relies on “adaptive governance” and “the application of the precautionary principle to facilitate protective action in the face of ongoing uncertainty” (S. Brown, 2009 p. 610-611). He is not alone in this way of thinking. Van Asselt and Vos (2008)’s uncertainty paradox aligns here since it allows for scientific uncertainty to co-exist in a risk situation that provides certainty. As they explain it, the uncertainty paradox is “an umbrella term for situations in which uncertainty is acknowledged, but the role of science is framed as one of providing certainty” (p. 281) .

To conclude, the literature suggests that deficit models have useful features since people do need accurate scientific information about risk. However, even if made more ‘user-friendly’, they remain inadequate because they position the technology that

¹ The US Government created the Superfund law to manage the identification, assessment and management of thousands of contaminated sites spread throughout the USA.

brings the risk into play as a *fait accompli*, and assume that because it is manageable, it is therefore acceptable.

So what models allow for the wider context of scientific risks to be represented?² Let's now consider the advantages and limitations of dialogue models which frame expert knowledge in its socio-political context.

Dialogue models of risk communication

"We have [found] a diverse group of citizens [to be] remarkably open-minded about risk issues, once allowed to express themselves in their own terms on their own concerns ... they were typically quite willing to consider a shift from technology- to risk-based regulation, assuming that rigor of enforcement was assured" Fischhoff (1998 p. 65).

Dialogue models emerged as a response to the shortcomings of deficit models. In the broadest sense, they preference risk dialogue over risk content, and presume that a consciously democratic process can deliver the desired outcome because they prioritise a two-way engagement between experts and non-experts. (Álvarez-Farizo et al., 2009; Boholm, 2008; P. Brown, 2009; Dijkstra & Gutteling, 2012; Gregory et al., 2006; Irwin, 2007; Pearce & Littlejohn, 1997; Public Dialogue Consortium, 2016; Susskind & Field, 1996; Sword-Daniels et al., 2016; Vandermoere, 2008).

Dialogue models accept that there is a social and political context associated with an empirical risk, give preference to contemporary values around social inclusion and transparency, and recognise non-experts' right to negotiate a risk level with experts. In this way, dialogue models are considered to "improve the scrutiny and accountability of science" (Evans & Plows, 2007 p. 827). Essentially they aim to achieve a balance of power between experts and non-experts, the pursuit of a fair process of risk selection, and acceptance of knowledge contestation. By allowing for interaction and reflection, adherents argue that these models have the capacity to resolve conflict through a consensus-based approach (Gallagher & Jackson, 2008; Roelofsen et al., 2011; UNDP). In this way, dialogue models involve more than asking questions about a technology risk, as occurs with the deficit model. They

² The Oxford English Dictionary defines context as "the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood" anon. (2014). *The Oxford English Dictionary* Oxford University Press.

champion the right to interrogate the knowledge that underpins risk assessment, and the right to know what level of competence is on offer to manage risks.

There are various iterations including the risk dialogue model, the interactive understanding model, the deliberative model and the rights-based approach. B. Wynne (1996), Wynne (1988), Irwin (2007), Wardman (2008) and Álvarez-Farizo et al. (2009) offer a number of iterations.

To varying degrees, all models preference features such as civics, and individual rights, the exchange of ideas and experience, understanding (S. Owens, 2000) and reflection, and stakeholder engagement (Kiker et al., 2005, Cundy et al., 2013). Cox and Lowrie (2015)'s version emphasises the need for an understanding of people's cultural situations and sets of beliefs, or as Taylor-Gooby and Zin (2006) put it, the cultural framing of risk communication. Reed et al. (2014) allow that knowledge is "context- dependent and strongly related to an individual's perceptions and world-view" (p.342), and associate stakeholder engagement with the term 'represent'. They frame knowledge exchange within a set of five principles (pp.340-341). Broadly speaking, these attributes reflect the psycho-social and socio-political context of risk.

Dialogue models tend toward strong constructionism and embrace the construct of civil society, preference contemporary values around equity, social inclusion and identity, and emphasise interaction, reflection, mutual learning, and recognition of different knowledge forms, ideas, experience and values between groups (Boholm, 2008; Evans & Plows, 2007; Hargreaves & Ferguson, 2001; Hitlin & Piliavin, 2004; Laurian, 2003; Public Dialogue Consortium, 2016; Slovic et al., 2004; Susskind & Field, 1996).

So where is knowledge positioned in these dialogue models? It is 'knowledges', not 'knowledge' that apply, with epistemological tension between around contested knowledge always in play. Fischhoff (1998) understands this as a key feature of dialogue models when he proposes that scientific knowledge can function as "a tool of disenfranchisement .. if analytical processes supplant participatory ones." (p.65). What is required is the mutual sharing of knowledge through reflective discourse, as that recognises the non-expert's right to 'speak truth to power' (UNDP, 2009).

Speaking 'truth to power' refers to strategies that address social and economic

inequality by legitimising the voices of those with little, or no power. An international body aligns this slogan with civic engagement when it proposes that “participatory governance through civic engagement today focuses on creating inclusive and responsive democratic institutions and increasing opportunities for citizen voice” (UNDP, 2009 p. 8).

The question arising from the slogan ‘speak truth to power’ is ‘what truth and whose power?’. How much power can non-experts really have? Slovic (1998) defines risk as “an exercise in power” (p.76) and Irwin (2007) takes a similar view when he argues that organised interest groups, elites and professional experts are “the main institutional actors who make choices among technologies” (p.3). So where do non-experts fit in? In this regard, a critical aspect of dialogue models is their assumed inclusive nature and rights-based approach which allows for such voices, accommodating what can be uncomfortable discussions around the transparency, legitimacy and uncertainty of scientific knowledge.

People with little or no power can choose to take different approaches to a risk dialogue, asserting their rights as individual to engage at whatever level they choose. They might not be interested and behave with “wary indifference” (Luhmann, 1979 p.22), or they might play a role as disinterested citizens (Evans & Plows, 2007), with an interest in a risk issue, but no particular ideological axe to grind. These citizens are comparable to Zsolnia (2003)’s properly socialised persons, Irwin (2007)’s scientific citizens or S. Owens (2000)’s active citizens. These latter are people “willing, able and equipped to have an influence in public life and with the critical capacities to weigh evidence before speaking and acting” (p. 1146). Evans and Plows (2007) also allows a “positive role for non-expert citizens in the democratic control and oversight of science” (p.827)

A favoured form of representation of social engagement is often referred to as a spectrum of activity. The spectrum includes settings such as ‘informing’, as per the deficit model, and ‘involving’ and ‘collaborating’, as per the dialogue model. For example CRC CARE (2019) refers to models that “reflect a spectrum of degrees of engagement that range from providing information through to collaboration and empowerment” (p.6), and Cundy et al. (2013) refer to a process involving increasing interaction and engagement. In this schema, shown in Figure 2.1 below, a mix of

activities is possible at any one time. They explain that the spectrum “is not intended to show a ‘flow’ of activities, as stakeholder engagement activities are frequently iterative and non-linear in nature and may involve the full range of these measures” (p.286)

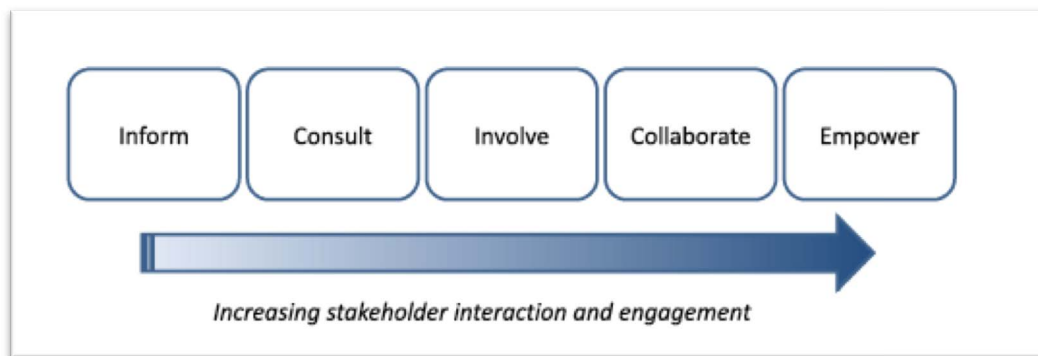


Figure 2.1. Spectrum of stakeholder engagement and empowerment activities. Cundy et al. (2013 p.286)

However, Figure 2.1, on face value, does not necessarily convey this because the left-to-right pointing arrow conveys the idea that more engagement equates to a better process. It fails to identify any sweet spot on the spectrum of activities, including how various knowledge forms are positioned within each form of engagement.

To this point, we can see the advantages of dialogue models with democratic aspirations. Now let's turn to their limitations. There are a range, including first and foremost, when a technology is rejected on principle, and cannot be negotiated. Pidgeon et al. (2007) propose that when individuals hold strong preconceived beliefs, nothing will change their position on a technology they oppose. Kasperson et al. (1998) is aware of this conundrum when he asks “who can legitimately claim the right to select the values or preferences that should guide collective decision-making, in particular when health and the lives of humans are at stake?” (p.56) Scheer et al. (2014)'s construct of the *strategic problem* is in play here since it points to the role of special interests in influencing the inequitable distribution of risks. Special interests apply to “business and industry stakeholders”, “environmental and consumer organisations’ and “public authorities” (p.12) Gregory et al. (2006)'s solution is recourse to institutional change that supports well-structured and open discourse that can reconcile values and rational decision-making, advising attention to the “risk

handling process,...establishment of public-private partnerships and participatory processes...involving stakeholders...media, cultural elites and opinion leaders and 'affected' and 'observing public'" (Renn, 2006 p. 49). Zsolnia (2003) also defaults to an institutional remedy, proposing "a procedural model of responsible decision making" [p.288] that takes a multiple values perspective, where the ethical norms in play around value preferences are identified. Pollard et al. (2004) agree but fail to clarify how to include competing values in decision-making, as illustrated in the confusion apparent in their table, "Integrating decision-support tools: some key challenges" (p.23.) Fontaine (2008) offers more practical advice by identifying techniques that support public participation. One technique is the creation of a project narrative that weaves technical information "into an overall project narrative that gives context" and allows people to "relate it to their daily lives." (p.233). Processes need to be managed at the right pace by taking small, connected steps that build upon each other. The limitation here might be not so much in the technique, but in the resources available to bring it to fruition. Another solution is Reed et al. (2009)'s typologies of participation ³ that include participatory situations around open space forums, roundtables, negotiated rule-making exercises, mediation, or advisory committees that include scientists and stakeholders. Again, these are familiar remedies around the overarching principles of 'inclusion' and 'participation', so the question is, 'what happens in these settings?' Once seated at the table, how do people participate? They might, as Stoffle and Minnis (2008) explain, use vernacular forms of speech which, whilst possibly needing translation, do have intrinsic value. The use of vernacular speech might be one of Meadows (1999) leverage points that facilitate dialogue. She proposes that individuals can promote inclusion and participation by acting as "boundary spanners"⁴ who act "as negotiators on behalf of the field whose interest they represent" (p. 5).

This brings to mind the idea of fair process. It involves two-way communication (Fischhoff, 1998), and representation, collaborative framing and connection between process and outcome (Petts, 2008). The advantage offered here is around active relationships between experts and non-experts, not just linear communication one

³ See Table 1. p. 1937

⁴ Here the word 'spanner' refers to a person who is capable of spanning a gap or making a bridge, as opposed to a tool which is used to repair a machine. The different meanings are conveyed through the different pronunciation of each term.

way, and then the other. Active relationships allow for thoughtful questioning and scepticism by the public, and foster critical, as opposed to general or social trust (Petts, 2008 p.832). So how does inclusion work? How are people empowered to participate? Petts (2008) proposes that when experts deploy a dialogue model approach to risk communication, they can create roles where people act as “gatekeepers of knowledge, concerns and values” (p.826) and thereby allow “experiential knowledge” (p.830) to be considered. Fontaine (2008) “independent credible champion” aligns here. They can be “an elected official or acknowledged public figure” and their role is to facilitate legitimate contestation about a risk situation and risk selection. To do this, they need to be “trustworthy, able to communicate and have strong ties to the community” (p.223)

At this point, we can ask whose values should be preferred, and how conflict between values could be resolved. Does it necessarily follow that dialogue-based social engagement accounts equitably for everyone’s values? Bessette et al. (2017) is not convinced, finding that economic values are prioritised at the expense of those around environmental health or culture, which “are often ignored” (p.1193). Gregory et al. (2006) point out that excluding local knowledge from decision-making process is not only counter-productive, but can also be illegal (p.727), and similarly, Spash (1997) finds that people who hold “rights-based beliefs about significant environmental issues” may be excluded from public dialogue, which “is liable to be undemocratic” (p. 403).

Other research also questions the assumption that dialogue models deliver satisfactory outcomes for all interested parties. Hillier et al. (2009) find that “wide access to public processes is no guarantee of substantive equity where resources are inequitably distributed amongst participating stakeholders” (p.1606), and Benn et al. (2009) propose that an equitable process can lead to a perverse outcome by legitimising a decision-making process that provides support for risky technology, and S. Owens (2000) is similarly sceptical about forms of participation that “are discursive, detached and consensus-dependent”. She argues that even improved dialogue models could be “just as much about legitimation as the ones they seek to replace” (p.1145), and proposes that dialogue models are less effective than those that are “practical, committed and ready for conflict” (pp. 1145-1146). It is a refreshing

approach in that it allows for expertise, (“practical”), aims for outcomes, (“committed”) and incorporates distrust into the mix (“ready for conflict”).

Researchers point to limitations of dialogue models. There can be too much emphasis on psycho-social aspects of discourse, which can allow participants to lose sight of their main objectives (Gurabardhi et al., 2004). Petts (2008) rejects the assumption that there is a causal relationship between dialogue and the generation of trust. The critical point here is that dialogue models focus on process rather than the purpose of the process, which might allow people to lose sight of their objective. For example, R. Gregory et al. (2001) point to their tendency to expand an agenda to the point where it becomes unwieldy. Irwin (2007) agrees, citing evidence from the European STAGE project that found that more debate generated more issues, and that open-ended dialogue did not necessarily ‘fix’ the trust problem (Irwin, 2007 p.34). S. Owens (2000) concedes that “the signposts remain confused, because the destination is not only distant but involves a greater challenge to the status quo than has hitherto been acknowledged” (p.1147). She calls for “democratic engagement in the formation and articulation of values, and in policy formulation” (p.1144) but fails to explain what this would involve, how it could be done or what value it might provide.

One solution to Owen’s problem might be a change in focus. Irwin (2007), Vandermoere (2008) and McDonell (1991) point to the neglect of opportunities that support discussion about benefit as well as risk, and point to the resultant failure to focus on mutually-agreed upon outcomes. Vandermoere (2008) finds that deliberative methods of social engagement can be effective if they bring forward discussion of benefit by facilitating people’s interest in decontamination of the environment and promoting their willingness to act in their own self-interest. He identifies a limitation of strong constructionist versions of the dialogue model around their emphasis on the dialogue itself as the reason for a social engagement process, rather than as a way to achieve a mutually agreed outcome. Pezzullo (2007)’s focus on toxic tours exemplifies this problem. In her schema, engagement involves interaction between people from working-class black communities who have experienced environmental injustice, and people from other social groups and sub-cultures, in the main middle-class and white, who want to experience and engage in dialogue with them about their pain and need for justice. The dialogue is about ill-health and the need for environmental justice but Pezzullo fails to explain what this might involve except recourse to the courts. There

is no mention of scientific processes that could rehabilitate a damaged environment and scant mention of, the need to share information. Rather the focus is on social processes that allow others to witness and validate the pain and injustice experienced by people living in contaminated communities.

Santos and Chess (2003) propose that a process should deliver an outcome within a given time frame, and not just exist as an end in itself. Similarly, Healy (2009) finds that more talk does not equal better outcomes and paradoxically, could lessened the participatory power of non-experts rather than increase it. In an odd twist, he finds that unlimited dialogue is more likely to be associated with deficit, rather than dialogue models because community participation does not automatically imply equality of agency. In this sense, if non-experts become out-of-their-depth during discussion because of information complexity, their input to a process might be marginalised.

At this point that we can appreciate that acknowledgement of power relations and agency within a decision-making process is a key characteristic of dialogue models, and that variable understanding of scientific knowledge is an inherent limitation. In other words, regardless of the type of process that is deployed, the technical content of the risk dialogue can be beyond the comprehension of non-experts unless experts have the capacity to explain it in layman's terms, and unless non-experts are willing to listen. In other words, dialogue models might not be entirely fit for purpose regarding risk communication. Whether they are or not will be considered in Chapter 9, but here it is important to note that international agencies, national governments, academic and other institutions tend to rely upon dialogue models when issuing in formal guidance. (Heath et al., 2009; Sustainable Remediation Forum, 2011; UNEP, 2002)

Let's look at some examples. There is an Australian handbook for professionals that provides guidance about fair process (Heath et al., 2010). It identifies the need to understand social perspectives, appreciate the value of consensus-based decision-making and acknowledge that expert knowledge is incomplete. British research positions risk communication as part of a sustainable remediation framework that can address ethics, social justice, inter-generation equity, equality, locality, amenity and inclusiveness (Sustainable Remediation Forum, 2011). The framework acknowledges community antipathy to transferred risks, and aims to facilitate a balance between

benefits and trade-offs. Transparent record keeping and the acknowledgement of assumptions and uncertainties are considered important.

Australian guidance on risk communication and engagement is provided by a National Environment Protection Measure (NEPM) (National Environment Protection Council, 2013). It proposes that risk communication is best seen as a two-way process that gives prominence to trust, credibility, inclusion, participation, empowerment, fairness and empathy, and proposes that these factors mean more to the community than facts and figures. The NEPM emphasises the need for clear content and stresses the need “to ensure messages and actions are constructively formulated, communicated and received” (p.2). Opportunities for people to express negative emotions are recognised as valid, as is the importance of showing respect for the community’s intelligence. So far, so good, but one can ask as to the intended purpose of the NEPM. It may not be as democratic and caring as it purports to be, since the guidance is directed to industry or government stakeholders, and emphasises how these groups can manage risk amplification by the control of content and content delivery. In short, it is about managing the community’s expectations about risk levels. There is no specific reference to remediation as a risk reduction process, or to peoples’ experience of it. Values are only mentioned once, in relation to property values, and only two historic case studies are provided. Given this, although the NEPM purports to reflect a dialogue model, this is misleading since this model requires recognition of competing values and transparency. The NEPM is better understood as an iteration of the deficit model of risk communication, albeit an enhanced version.

At this point, we can see that both deficit and the dialogue models have advantages and limitations. The advantages of deficit models are associated with utilising the competence of experts to solve a problem, and their limitations associated with the preference afforded to scientific knowledge, and assumptions made about experts’ competence. The advantages of dialogue models lie with their acknowledgement of the social and political dynamics of decision-making, and alignment with democratic values. Their limitations lie with their focus on process rather than the purpose of the process and their failure to address perception and the way individuals think about, and respond to risk situations. We can go now to consider the third model of risk communication, which does just that.

Mental models of risk communication

Mental models focus on how individuals process risk knowledge. They lie within the domain of psychology and “are personal, internal representations of external reality that people use to interact with the world around them” Jones et al. (2011 p.1)

Mental models provide reasons as to how and why individuals and different epistemic communities select and negotiate their particular version of risk. In this way, they legitimise contestation about a risk situation

The models allow for two modes of thinking, one being the analytic mode, the other the experiential mode (Slovic et al., 2004 p.311). The analytic mode “uses algorithms and normative rules such as probability calculus, formal logic and risk assessment and is relatively slow, effortful, and requires conscious control”. The experiential mode “is intuitive, fast, mostly automatic, and not very accessible to conscious awareness” (p.311). It influences how people perceive phenomena, particularly potentially threatening ones. It is “the most natural and common way to respond to risk. It relies on images and associations, linked by experience to emotion and affect (a feeling that something is good or bad)”. (Gregory et al., 2006 Table 1., p. 313).

The two modes of thinking operate in parallel, with “fast, intuitive, and emotional response anchor(ing) initial evaluations of risky prospects, which slower cognitive pathways may then adjust” (Greenberg et al., 2012 p.772)

This balancing between the two modes is required for rational decision making. In this schema, decisions regarding the management of management of risk must be guided by both reason and emotion (Morgan et al., 2002). Greenberg et al. (2012) thinking aligns here since they find that when there is unresolved tension between the two modes, risk communication tends to fail.

Scholars have arrived at a broad consensus about the central place of mental models in risk communication theory (Botterill & Mazur, 2004). To varying degrees, they accept the conditionality of all knowledge forms, and allow that there are multiple aspects of culturally constructed risks. These situations explain why there can be a mismatch between empirical and perceived risk. See for example Renn et al. (1992), Wynne (1988), Joffe (2003), Boase et al. (2017) and Bergman (2012).

The contribution of psychology to risk research is not new. Greenberg et al. (2012) acknowledge this when they reviewed 30 years of risk literature. They find that “about half of the 20 most cited articles...are the product of the contribution of psychologists...Some assert that we should base our risk perceptions on rational deliberation. But research shows that our perceptions are heavily influenced by what we feel about a hazard and the people who manage it” (Greenberg et al., 2012 p.772). They note that risk perception is generally accepted to be dependent on both cognitive (analytical) and emotional (experiential or non-cognitive) thinking, the latter which involves psychological processes known as heuristics.

Described as mental short-cuts, heuristics are the immediate, intuitive responses of a person to an external stimulus (Boholm, 2008; Finucane et al., 2000). As subconscious tools that process information, heuristics are more influential on an individual's perception of a risk than conscious thinking and cognition. (Slovic et al., 2004). Both ways of thinking are valid and there is a relationship between them. In this regard, Gregory et al. (2006) reference to the work of Damasio (1994) is instructive. This neurologist proposed that “rationality is not only the product of the analytical mind, but of the experiential mind as well where concrete images, metaphors and narratives are in play” (Slovic et al., 2004 p. 321).

Gregory et al. (2006) find that an external stimulus like a risky technology can elicit a range of heuristics. Here, we mention two. The availability heuristic refers to the ease with which examples of a phenomenon can be recalled from the unconscious to the conscious mind. The affect heuristic allows an individual to draw on memory and experience, and upon their own “affect pool” of “perpetual and symbolic interpretations. Gregory et al. (2006) point to the important role of affect and emotions in people's decision processes, especially when a decision involves a difficult trade-off, or where there is interpretative ambiguity as to what constitutes the ‘right’ answer. It is worth noting that Greenberg et al. (2012) ranks the affect heuristic as first among ten major accomplishments of risk analysis. Its importance lies in the idea of thinking fast as opposed to thinking slow, a schema made popular by Kahneman (2011)

Finucane et al. (2000) propose that the affect heuristic resembles the primary evaluation process in judgement of risks and benefits. It draws on the readily “available affective impression” of the stimulus (Slovic et al., 2004. p.314-315.). Let's take a

situation, for example, where the stimulus is a risky contamination situation that people do not anticipate or cannot control. It would not be unsurprising that such people might adopt a position of fear or dread which could derail a risk dialogue. Here, the influence of the affect heuristic would be to judge the risk as unacceptable. In Sandman (2012)'s schema, it is not so much fear or dread, but more a case of disgust or outrage. He represents this situation with the now familiar and widely used formula of 'risk equals hazard + outrage'.

The value of considering heuristics in risk communication is acknowledged, for example by Connell et al. (2007) who finds that the most effective mechanisms for communication were typically those with strong heuristic value. What makes them effective lies in the understanding that a person's instinctive, immediate response to risk is not irrational, rather connected to biological regulation that allows someone to make a quick decision when needed without resorting to the lengthier process of reasoning (Finucane et al., 2000; Sjöberg, 2006; Slovic et al., 2004).

Ropiek (2011) also accounts for people's perception of risk. It is "...the way we interpret information in order to survive — is a subjective, affective mix of facts and feelings, intellect and instinct, reason and gut reaction" (Ropiek, 2011). He finds that people initially react instinctively to poisons through the senses or through memory, and when presented with a risk situation, interpret empirical risk knowledge using affective, emotional, and instinctive psychological cues, regardless of scientific evidence. Ropiek (2011) stresses the need for experts to understand that the subconscious processing of information is more influential on risk perception than conscious processing using cognition.

At this point, we can turn to the perception of risk. Gregory et al. (2006) allows for a variety of construction principles for conceptualising risk. Different disciplines, and stakeholders, including those drawn from civil society develop their own perspectives on risk. When responding to risk, all do so "according to their own risk constructs and images. These images are called 'perceptions' and they have been intensely researched in relation to risk" (p.31), with a consensus around the view that perceptions combine common sense, reasoning, personal experience, social communication and cultural traditions.

Here we see that context is the deciding factor in an individual's assessment of risk.

Context includes the characteristics of the risk in its empirical form, as well as mental images, associated stigma effects, and affect and emotions. Gregory et al. (2006) summarises a range of research when he explains that context is “particularly relevant when individuals face a decision ... where there is interpretative ambiguity as to what constitutes a ‘right’ answer. In these cases, people often appear to resolve problems by focusing on those cues that send the strongest affective signals ... Faced with an eminent threat, humans react with four basic strategies: flight, fight, play dead and, if appropriate, experimentation (on the basis of trial and error). (p.31-33)

Regarding imagery, its importance in risk perception is established in an experiment by Visschers et al. (2008) when they compare people’s reaction to a video and to text. They find that imagery, as presented through video affected the experiential process of a perceived risk, whilst text affected the analytical process and the risk message. This experiment demonstrates the unique position of imagery in affective, as opposed to rational response to a risk, and points to the tension between fact and feeling. It is something that experts engaged in risk communication experience when they aim to explain the difference between empirical and perceived risk to people living on or near contaminated communities.

At this point, we understand that the perception of risk relies initially upon the heuristic responses to an empirical risk. Two books have shown heuristics in play in communities impacted by contamination risks. We have referenced Pezzullo (2007) toxic tours above, and here suggest that they position this heuristic response to contamination risks as a political tactic to address corporate power and lack of accountability. Edelstein (1988/2004) alludes to heuristics responses when he documents the emotional responses of Americans, mainly white working-class white people affected by site contamination during the Love Canal era.⁵ These people draw upon their memory of past injustice and then direct their anger at institutions they believe are responsible for the problem.⁶ In Pezzullo (2007)’s schema, toxic tours are proposed as an exercise in “the democratic tactic of resistance” (p.102) and “an intervention to redefine public participation in

⁵ Love Canal was an American community near New York which was built on a former toxic waste dump. The entire community was exposed and many people contracted cancers and other diseases associated with exposure to dioxins.

⁶ “Toxic Tours” refers to organised bus tours of contaminated sites in Louisiana’s Cancer Alley.

environmental decision-making” (p.51) that enable “a negotiation of power” (p.8). What is missing in this schema is any mention of dialogue with experts who can apply remedies to reduce or eliminate site contamination. Whilst it requires accountability, it omits mention of key players who might have the capacity to enforce accountability by way of site remediation.

One measure of accountability is described by Tucker (1995) as institutional recognition of peoples’ psychological responses to hazardous substances. Gallagher and Jackson (2008) understand this when they identify a role for heuristics in the design of a social engagement process associated with contaminated site clean-up. They find that when heuristics are recognised, a more successful outcome is likely. For example, some advisory committees were identified as examples of good process because committee members made people feel that they were being treated fairly and with respect, and because their input was not perceived as tokenistic. Similarly, Petts (2008) finds that when experts take time to listen to people in their homes, share a cup of tea and a chat, they bring forward a positive emotional response, including feelings of trust towards the expert.

Overall, mental models assist understanding about why conflict arises in situations where contamination risks are in play. They are useful because they bring forward understanding of how perception and experience influences an individual’s construct of risk. However, they have limitations that constrain their exclusive applicability to the understanding of why gaps in communication occur between different groups. A key criticism is their tendency to overemphasise the individual, focus too much on risk perception and underestimate the influence of external issues, particularly power relations and agency (R. Gregory et al., 2001). As we have seen above, it is dialogue models that account for the influence of socio-political issues. As S. Owens (2000) finds, mental models “say little about the mechanisms controlling collective and structured environmental behaviour and the potential for changing it” (p.1143)

At this point, we can leave discussion of the three overarching models and explore two frameworks that account for risk, impacts, conflict and cooperation.

Two useful frameworks

Research identifies frameworks that offer ways to conceptualise the relationship between empirical and perceived risk. I'll start with a well-known example known as the Social Amplification of Risk Framework, referred to as SARF (Kasperson et al., 1988; Renn et al., 1992).

SARF accounts for the amplification of risk by identifying a sequence of contributing factors associated with social, political, and psychological responses to a risk event.

As Gregory et al. (2006) initially explained, the amplification process “starts with either a physical event ...or the recognition of an adverse effect In both cases, individuals or groups select specific characteristics of these events or aspects of the research findings, and interprets them according to their perception and mental schemes.” (p.140)

SARF is seen below in Figure 2.2. as a network diagram showing the factors that contribute to risk amplification. As Kasperson et al. (1988) explain it, SARF accounts for “information processes, institutional structure, social group behaviour, and individual responses (which) shape the social experience of risk, thereby contributing to risk consequences” (p. 181). With respect to social and political responses to risk, SARF allows for factors around the construction, ownership and distribution of risk knowledge, social conditions and individual situations. With respect to psychological responses to risk, SARF allows for personal experience, individual senses and what they call “intuitive heuristics.”. As for risk consequences, they first appear as “ripples”, effecting individuals as well as commercial, legal and administrative situations, and then can extend and become impacts. Impacts include loss of business, financial losses, regulatory constraints, loss of confidence in institution, and increase or decrease in physical risk.(Kasperson et al., 1988)

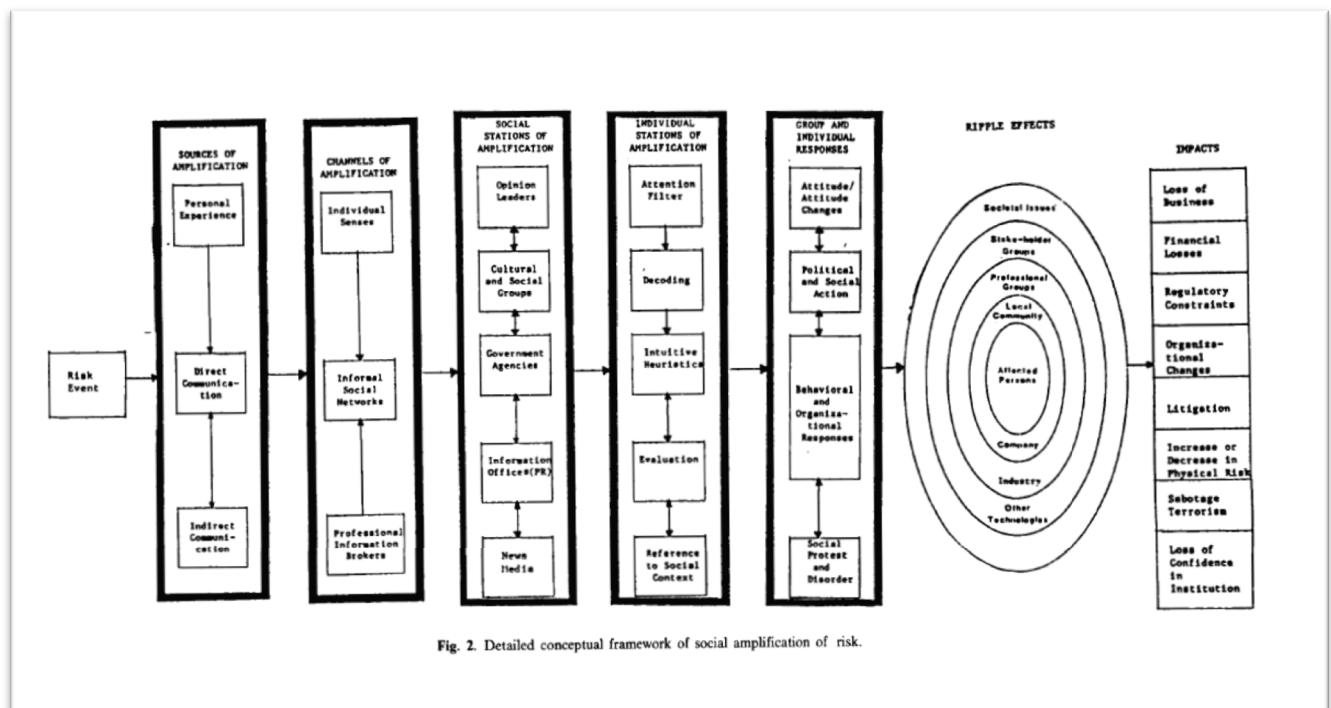


Figure 2.2. Representation of the Social Amplification of Risk Framework.

Kasperson et al. (1988 p. 183).

Limitations of the SARF construct include its' ambitious scope and the dominant positioning of risk as a negative, with one benefit identified, being that which could accrue from a risk situation in the form a decrease in physical risk. From a historical perspective, it is understandable that SARF aligns risk with negativity. Risk events that occur during, or prior to the year in which it was developed include Bhopal, Love Canal and Seveso, and Kasperson specifically refers to them (Kasperson, 1986)⁷, as do Bohnenblust and Slovic (1998), who propose that such catastrophic accidents create signals because of their consequences. It can hardly be claimed that any benefit came from these catastrophes in the short term, but over the long-term, they functioned as a catalyst for reforms in the chemical manufacturing industries in many countries, including in pollution monitoring and control, and the implementation of more protective legal frameworks. (Eiser, Stafford, Henneberry, et al., 2009; European Commission, 2014; Warner M et al., 2011; B. Wynne, 1996).

⁷ Chapter Four makes findings about the social significance of these and other events using results from the Milestone Questionnaire.

To summarise, SARF is an established model that integrates social, political, economic and psychological factors as a way to explain how empirical risks can be amplified over time in the public mind.

The second useful framework is provided by Earle et al. (2007). It is called the Trust, Confidence and Cooperation Model (TCCM), and focuses exclusively on psychological processes, differentiates between confidence and trust and allows for their interaction. The authors nominate it as a model rather than a framework, but for the purposes of the following discussion, the distinction between a framework and a model is not critical.

TCCM is based on psychometric measures that build cooperation around cognitive and emotional processes associated with a dynamic relationship between trust and confidence (Siegrist et al., 2005) (Siegrist et al., 2007). Earle and Siegrist (2006) propose that the TCC Model provides “a more unified understanding of the primary pathways to cooperation” (p. 410). Its model aligns with Gregory et al. (2006 p.311)’s proposal that both analytical and experiential systems need to be in play when decision-making about a risk is required. In this way, it allows for the presence of those who need to be trusted, and those who need to trust others (Earle & Siegrist, 2006; Earle et al., 2007; Siegrist et al., 2005).

TCCM is represented below in Figure 2.3. as a network diagram that connects values with the generation of social trust and professional performance with confidence. Making a distinction between trust and confidence is important in situations where cooperation is required. Put simply, when the person who needs to be trusted performs in a manner that generates the confidence of those who need to trust, cooperation between the two groups can occur.

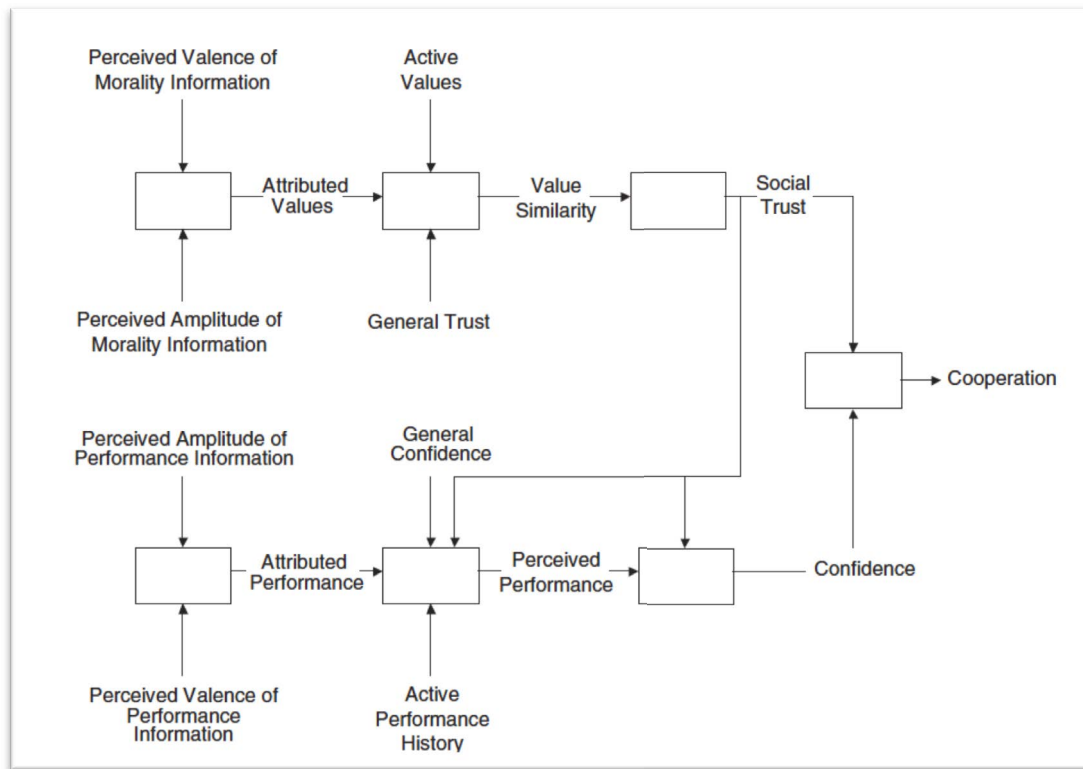


Figure 2.3. *The Trust, Confidence and Cooperation Model. Earle and Siegrist (2006 p.387)*

In this schema, trust is “social trust”, and associated with “social relations, group membership and shared values“, whilst confidence relies on knowledge and familiarity (p.399), and on “past performance, or institutions designed to constrain future performance” (p. 386). Siegrist et al. (2005)’s perspective is helpful here as it anchors trust in “social relations in general (i.e., general trust) as well as positive expectations towards systems in general (i.e., general confidence)”. In other words, trust involves people interacting with each other rather than just thinking. In this sense then, trust is contingent on similarity of intentions or values, and confidence on judgements of past performance and evidence.

So which is more influential in building cooperation? Trust or confidence? In the TCC Model, it depends on the degree of familiarity that is in play in a situation. As Siegrist et al. (2005) explain: “trust involves risk and vulnerability, it is important when familiarity is low. Confidence, on the other hand, is based on “high levels of familiarity based on experience or evidence” which allows people to believe “that certain future events will occur as expected’ (p. 147). Earle and Siegrist (2006)

unpack these ideas a little further and allow that “in times of low social uncertainty, when morality information isn’t relevant, social trust doesn’t play the dominant role in cooperation... (S)ocial trust becomes more important in times of uncertainty, when morality information is relevant”(p.388) ⁸ These researchers also allow for interaction between social trust and confidence when they explain that “social trust affects judgments of confidence both directly and via effects on perceived performance” (Earle & Siegrist, 2006 p.388). In other words, if expectations of the future are relatively clear (high familiarity), people can cooperate with others when they have confidence in their competence. If expectations of the future are clouded by uncertainty (low familiarity), people might cooperate with others if they share values, and thereby trust, these others.

The TCCM is potentially useful in this inquiry, as it draws upon findings from three empirical studies, and allows a specific role for professional performance when experts can provide evidence and call up the “regulations, rules/procedures, contracts...social roles...control...and standards” to frame the risk decisions (Earle & Siegrist, 2006, p. 386). Importantly, the model does not preference the experts’ knowledge over non-experts’ values, rather it gives priority to trust since, as their empirical research demonstrated, “judgments of trust dominated judgments of past performance and of confidence” (p.383). They also identify antecedents of trust that “include social relations ..morality .. integrity ...fairness, and caring” (p.386).

Earle et al. (2007) position the model as “compatible with our participatory form of democracy” (p.1). Mordini (2007) proposes the same for curiosity, finding that it can play a positive role in decision-making because it “is by definition a ‘democratic factor’”. When curiosity is in play, it can promote “information sharing and encourage dialogue ...(and) might allow people to overcome paranoid reactions towards new technology.” (p.546)

To conclude, both SARF and the TCC model offer ways to understand the nature of risk communication but if used exclusively to explain it, might founder.

⁸ In this schema, morality information is information about values and intentions.

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Appendix 3.1. In-Depth Interviews: Information.



CONSENT FORM

For

PARTICIPATION IN IN-DEPTH INTERVIEWS

I _____ agree to participate in an in-depth interview that will contribute to a research project called 'Integration Mechanisms in Risk Communication about the Selection of Remediation Design for Persistent Organic Pollutants: Bridging Content, Bridging Process and Perception Benefit. The university's reference number for the research is 2014000860.

The research is being conducted by Kathryn Hughes from the University of Technology, Sydney. Funding for the research has been provided by the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE). The research is for a PhD that explores risk communication and models of social engagement about the remediation of contaminated sites and includes collecting information through in-depth interviews

Kathryn's contact details are as follows Ph. _____.

Email _____@student.uts.edu.au

I understand that the purpose of the research is to identify information and social engagement processes that can close gaps in understanding between non-experts and experts. I also understand that my participation will involve one in-depth audio recorded interview of no more than 90 minutes. I also understand that the in-depth interview process has the potential to pose a risk to reputation or result in the professional embarrassment to me. This risk will be managed by the containment of questions within the scope of the project as described in the Information Sheet. In addition, attention will be paid to any commercial sensitivities nominated by me. The data collected will be de-identified during analysis to protect privacy. All interviews will be conducted at an agreed time and place.

I am aware that I can contact Kathryn Hughes or her supervisor, Jason Prior if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason.

I agree that Kathryn Hughes has answered all my questions fully and clearly.

I agree that the research data gathered from this project may be published in a form that does not identify me in any way.

Signature (participant)

____/____/____

Signature (researcher or delegate)

____/____/____

NOTE

This study has been approved by the University of Technology, Sydney Human Research Ethics Committee. If you have any complaints or reservations about any aspect of your participation in this research which you cannot resolve with the researcher, you may contact the Ethics Committee through the Research Ethics Officer (ph: +61 2 9514 9772 Research.Ethics@uts.edu.au) and quote the UTS HREC reference number 2014000860 . Any complaint you make will be treated in confidence and investigated fully and you will be informed of the outcome.



INVITATION TO PARTICIPATE IN IN-DEPTH INTERVIEWS

Project Title

“Integration Mechanisms in Risk Communication about the Selection of Remediation Design for Persistent Organic Pollutants: Bridging Content, Bridging Process and Perception Benefit”⁹

Dear

My name is Kathryn Hughes and I am a student at the University of Technology, Sydney.

I am conducting research into how risks and benefits about the clean up of contaminated sites and waste stockpiles are communicated to the community. I would welcome your participation in an in-depth interview. I have asked you to participate because of your professional expertise in the remediation or communication industries.

The in-depth interviews are part of research for my doctoral studies in risk communication theory and practice. The research is funded by the Cooperative Research Centre for the Contamination Assessment and Remediation of the Environment (CRC CARE).

You are under no obligation to participate in this research but your participation will be most appreciated. Every effort will be made to ensure minimal disturbance to your normal routine and your confidentiality will be respected.

If you are interested in participating in the in-depth interviews, please contact me by phone on [redacted] or by email at [redacted]@student.uts.edu.au

Yours sincerely,

Kathryn Hughes

[redacted]
Doctoral Candidate at UTS
Student Number [redacted]

NOTE:

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⁹ This is the original title of the dissertation. Approval to change to another title was sought and given by the Graduate Research School, UTS



INFORMATION SHEET

Title of Research Project

'Integration Mechanisms in Risk Communication about the Selection of Remediation Design for Persistent Organic Pollutants: Bridging Content, Bridging Process and Perception Benefit'¹⁰

This research is being undertaken by Kathryne Hughes, a doctoral student at the University of Technology, Sydney. It fulfils part of the requirements for a PhD in risk communication theory and practice. The principle supervisor is Jason Prior. Ph. 9514 4960/
jason.prior@uts.edu.au

The research is about how and why different groups of people communicate with each other about technologies that pose both risks and benefits to society. In particular, the research aims to find out if there are gaps in understanding between different groups of people about the risks of cleaning up contaminated land and explore why this may be so. To date, the research has found that experts and non-experts have different knowledge and understanding about this phenomenon and that when they discuss it during community consultation, the quality of communication between them varies. The researcher aims to find out why this variation exists and will collect information through in-depth interviews with professionals from the remediation industry and via a focus group of people who live within or near a completed remediation project.

If you participate in a focus group, you will attend a maximum of three meetings. Each meeting will take a half-day and will explore your understanding about, and experience of expert risk communication through dialogue and other non-invasive research techniques. Your private values and lifestyle choices will also be explored. The focus group will be audio-recorded and the number of participants will not exceed 14 persons.

If you participate in an in-depth interview, your expert knowledge and understanding about communicating clean-up risk to the public will be explored. There will also be some questions about your private values and lifestyle choices. Ten experts will be interviewed, each for a maximum of 90 minutes.

The data collected during in-depth interviews and the focus group will be de-identified during analysis to protect people's privacy and all participants will have access to the data that is collected.

If you have concerns about the research, please contact the researcher, Kate Hughes phone

email [redacted]@student.uts.edu.au/[redacted]@bigpond.com

If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer on 02 9514 9772, and quote this number 2014000860

¹⁰ This is the original title of the dissertation. Approval to change to another title was sought and given by the Graduate Research School, UTS.

THE RESEARCH PROJECT

‘Integration Mechanisms in Risk Communication about the Selection of Remediation Design for Persistent Organic Pollutants: Bridging Content, Bridging Process and Perception Benefit’.¹¹

THE RESEARCH TOOL

Interview *pro forma*

In-Depth Interviews

Researcher’s Introduction.

- Explain that you are interested in their knowledge, understanding and experience and also in the meaning of professional standards and the characteristics of expert content.
- Explain the distinction between techno-scientific experts in remediation and associated professionals in medical-scientific areas of hazard characterisation and risk assessment.
- Present them with the consent form to sign.
- Interview acknowledgement that they know the interview is being taped.

The following questions were used in the In-Depth Interviews

First Level Questions

Which is the most professionally satisfying site you have worked on?

How long have you been working in the remediation or associated medical- scientific disciplines?

What is your recognised area/s of expertise?

What are your qualifications?

Have you undertaken further training or study?

Do you travel in Australia and abroad for conferences?

What is your current title and role?

Is your work mainly office-based or field-based? A combination?

How many companies/agencies/institutions have you worked for over your professional career?

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Are you aware of 'private company values' expressed, for example in annual reports/web sites? If so, can you provide any detail about them?

What do you understand by the term 'corporate responsibility'?

What guidance documents do you routinely use in your work? e.g. from government and standard-setting bodies

Do you belong to any professional associations?

Did you have to get clearance from a person senior to you in your company in order to do this interview?

Do you have time to read books? What type of books do you prefer to read?

Do you watch feature films? Any particular favorites?

What are your hobbies? What do you do for recreation?

What colours do you like?

Do you belong to any community, service or sporting associations? Are you an active member of these organisations?

Where do you get your information about the external world from? The internet, newspapers, radio, other?

What do you use the internet for?

Has your health or the health of your family/friends/colleagues ever been at significant risk of harm due to exposure to industrial pollution at work, in the home or community, during war?]

What do you know about community exposure to hazardous chemicals? In Australia, in other countries?

Second Level Questions

What hazardous substances have you dealt with during remediation projects?

Can you provide an example of a difficult task that you have undertaken?

What changes have you seen to measurement instrumentation over time?

What techno-scientific uncertainties do you routinely encounter in your work?

Has the type of uncertainty you have dealt with remain constant or has it changed over time? If it has, why?

How does one deal with unexpected issues that arise on site?

Are there areas of expertise where you would recommend further training of remediation professionals?

What checks and balances exist within your company to ensure the integrity of your own work is maintained?

Do you have contact with other remediation professionals on a day-to-day/regular basis? Why do you need to communicate with them?

How well do you think different professionals within the remediation industry communicate with each other?

Third Level Questions

What level of knowledge do stakeholders such as developers and nearby residents have about remediation processes?

At a broad level, from a 'first principles' level, can you explain how human health is protected during a remediation process?

Are health risks that the local community asked to take during remediation differ from those taken by other groups, such as on-site workers?

What is the meaning of the term 'hazard'?

What is the meaning of the term 'risk'?

What is the meaning of the phrase 'taking a risk'?

Do non-experts understand the difference between hazard and risk?

What sort of people should undertake hazard assessment?

What sort of people should undertake risk assessment?

Standards for risk change over time. What have been the main drivers of changing standards?

What are the characteristics, or elements of, professional judgment?

Can you give an examples of excessive risk estimation in a policy setting?

Can you give an examples of insufficient risk estimation in a policy setting?

Fourth Level Questions.

What do you think the first indication of the existence of a remediation project would be for nearby residents?

What influences non-experts' understanding of remediation risks?

If a non-expert asked you something like; "can you show me something where I can read about this? What information do you consider non-experts should have access to when they are involved in a social engagement process?

How can experts demonstrate their 'independence' from private commercial interests and from contractual ties with government?

Has your integrity as an expert ever been challenged by non-experts? Why?

Have you presented techno-scientific information to non-experts as part of a social engagement process?

What qualities should it reflect?

Are images important.

If so

- how did you present your information?
- Do you use photos? Do you use tables? Do you use graphs?
- Do you use maps? Other diagrams?
- Do you use physical objects?
- Do you use a narrative technique?
- Do you explain site history? If so, why is this important?

What do you understand by the term 'private values'?

What do you understand by the term 'public values'?

What personal qualities should an expert reflect to a non-expert audience?

What role does professional judgment play in the design and implementation of remediation processes?

What are the most important aspects of an experts' communication skills?

What techno-scientific facts should experts present when discussing the risks of site remediation to non-experts?

Do you believe that you have established trust with non-experts during a social engagement process with which you have been associated?

What approach did you take to build trust with non-experts during social engagement?

Did you retain this trust? Did you fail to retain trust? If so, why?

Have you ever had access to information about health risks that has not been available to residents?

What is empathy?

Would you like to provide any further comments?

At the end of the interview, the researcher asks the expert if they have brought some examples of imagery that has been used in expert risk communication. If they did bring some imagery, the researcher asked the interviewee to describe what they brought and why they ranked it in the way that they did.

Appendix 3.2. Focus Group: Information.



Institute for
**Sustainable
Futures**



UNIVERSITY OF
TECHNOLOGY SYDNEY

Consent form for Participation in a focus group

I *[participant's name]*

.....

agree to participate in the research project '*Integration Mechanisms in Risk Communication about the Selection of Remediation Design for Persistent Organic Pollutants: Bridging Content, Bridging Process and Perception Benefit*'.

I understand that the research is being conducted by Kathryne Hughes, a doctoral student [No. 11794183] from the Institute for Sustainable Futures of the University of Technology, Sydney.

I understand that the purpose of the research is to explain why experts can fail to communicate with non-experts, and identify ways of improving communication between these two groups.

I understand that:

- 1) by signing this form, I consent to participate in a focus group facilitated by the researcher that will take a half day;
- 2) audio recordings will be made of the proceedings and safely stored in a locked unit, as per UTS's human ethics procedures;
- 3) when the audio recordings are transcribed, they will be kept in digital storage and be password enabled, as per UTS's human ethics procedures;
- 4) by signing this form, I agree to protect the privacy and confidentiality of other focus group participants and mediators.

I am aware that I can contact Kathryne on [REDACTED], or Dr Roel Plant, (Kathryne's Principal Supervisor, 02 9514 4949] if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish without giving a reason.

I agree that Kathryne has answered all my questions fully and clearly.

I consent to the information I provide being used for this research project in the following manner (cross out options for which consent is not given):

- ☐ The information I provide may be quoted in publications and attributed to me using the name and position details specified below
- ☐ The research data gathered from this project will be published in a form that does not identify me in any way, but the community of which I am a member can be specified

Participants Name

Signature

Date

Researchers Name

Signature

Date

NOTE

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Hello Friends,

Invitation to Participate in a Focus Group

I am finalising a research project about experts' ability to explain risks to people, particularly risks around the remediation of contaminated lands. The research is the final part of a research project at UTS. The focus group is being held to collect the perspectives of people who have experienced POPS remediation in their community.

For further information, please find the attached information sheet which provides more details. The other attachment is the Consent Form that all participants of the focus group will be required to sign when they attend on the day. It is there to protect privacy and ensure the participants understands the purpose of the focus group.

I'd like to schedule it within the next 3-5 weeks and the location will be either in the Botany area, or a little closer to the CBD, depending on availability of a suitable meeting space. I aim to hold the focus group at a place convenient for participating members and at a time that suits their personal schedules.

The key issue is whether to select a weekday or a day on a weekend to conduct the focus group. Evening is possible but not always easy for people so the day time is preferred. The focus group will take no more than 3 hours including a mid-way break, but excluding travel to and from the venue.

Please feel free to contact me by email. [redacted][@bigpond.com](mailto:[redacted]@bigpond.com)]. If you would like to ask me any questions before you commit, please feel free to phone [redacted].

I'd very much appreciate hearing back from you if you would like to participate. I can offer you interesting activities around expert's capacity to communicate about pollution risks and pollution clean-up, so I do hope you can find the time to attend. The focus group requires between 10-12 participants.

Let me know. Thanks so much.

Regards

Kate Hughes, PhD
Doctoral Candidate
Institute for Sustainable Futures
UTS
[\[redacted\]@bigpond.com](mailto:[redacted]@bigpond.com)
02-[redacted]

INFORMATION SHEET

Title of Research Project

‘Integration Mechanisms in Risk Communication about the Selection of Remediation Design
for Persistent Organic Pollutants:
Bridging Content, Bridging Process and Perception Benefit¹²

This research is being undertaken by Kathryn Hughes, a doctoral student at the University of Technology, Sydney. It fulfils part of the requirements for a PhD in risk communication theory and practice. The principle supervisor is Jason Prior. Ph. 9514 4960/
jason.prior@uts.edu.au

The research is about how and why different groups of people communicate with each other about technologies that pose both risks and benefits to society. In particular, the research aims to find out if there are gaps in understanding between different groups of people about the risks of cleaning up contaminated land and explore why this may be so. To date, the research has found that experts and non-experts have different knowledge and understanding about this phenomenon and that when they discuss it during community consultation, the quality of communication between them varies. The researcher aims to find out why this variation exists and will collect information through in-depth interviews with professionals from the remediation industry and via a focus group of people who live within or near a completed remediation project.

If you participate in a focus group, you will attend a maximum of three meetings. Each meeting will take a half-day and will explore your understanding about, and experience of expert risk communication through dialogue and other non-invasive research techniques. Your private values and lifestyle choices will also be explored. The focus group will be audio-recorded and the number of participants will not exceed 14 persons.

If you participate in an in-depth interview, your expert knowledge and understanding about communicating clean-up risk to the public will be explored. There will also be some questions about your private values and lifestyle choices. Ten experts will be interviewed, each for a maximum of 90 minutes.

The data collected during in-depth interviews and the focus group will be de-identified during analysis to protect people’s privacy and all participants will have access to the data that is collected.

If you have concerns about the research, please contact the researcher, Kate Hughes phone

email [REDACTED]@student.uts.edu.au/[REDACTED]@bigpond.com

If you would like to talk to someone who is not connected with the research, you may contact the

¹² This is the original title of the dissertation. Approval to change to another title was sought and given by the Graduate Research School, UTS.

Focus Group Design

The half-day program was designed to address the research questions and at the same time, to interest participants. It began with the signing of consent forms by all participants. They were collected and placed in a secure separate folder. A form to record personal details was made available for participants to fill in after the completion of the focus group.

The core part of the program involved two main activities, book-ended by two quick exercises. The quick exercises were Activities One and Four, and involved all participants as a group. Activities Two and Three were the main activities. After the first quick exercise (Activity One), the participants were divided into two groups, and located in two adjoining but separate rooms. The division was made to allow all participants the opportunity to contribute to the discussion, since my aim was to establish what all participants think about the same images and texts. In this way, the focus group was conducted to record a breadth of opinion, not for comparison between groups of participants.

The two participants from Rhodes and a married couple were assigned to different groups to allow for their views to be available to each group. The other participants were randomly distributed. Each of the two volunteer facilitators was assigned to a group. Their role was to explain what was required for each activity, provide guidance when required, and maintain the program schedule, and thereby ensure that participants' perspectives were accurately represented. As the convenor, I moved between the two groups, providing support to the facilitators and participants as required. At the completion of Activity Three, the group re-convened as a whole and a second quick exercise was undertaken. All conversation was recorded and the recordings retained for later transcription and analysis. All group notes and any other paperwork were collected and retained for later analysis.

Activity One

Activity One was a quick exercise aimed to gather the immediate, heuristic responses of all participants to the idea of 'the expert'. I asked the participants to think of an

expert or experts that they had met and listened to then use sticky notes to write down the first thought or thoughts that came to mind. Participants could provide one word or a couple of words. The sticky notes were then collected and stored.

The collected data revealed a range of responses and I used thick description analysis to classify them. First, I selected words that convey positive, and negative or ambiguous meanings. Secondly, I selected words that describe expert's attributes and personality. Table X below summarises the analysis

Activity Two

Activity Two focussed on the communication of expert knowledge about land contamination and remediation. Over an hour, participants explored expert text and imagery about these situations and provided perspectives on their quality. The contaminants were dioxins, a first generation group of POPs, and PFAS, a second generation group of POPs (see glossary). Participants were first asked to focus on five images. Three were simple and all depicted risk management situations. Participants had one minute to look at each of five images, followed by four minutes of group discussion about each. The group facilitator explained that they could use sticky notes and adhesive dots to identify particular attributes of each image and record notes about them.

Following this, participants were asked to focus on two texts and one diagram. containing both text and imagery. The diagram depicted sources of PFAS contamination, one of the texts was a 4-page guidance statement from the Australian Government about PFAS risks, and the other was a 2-page Fact Sheet about PFAS from the NSW EPA.

The facilitators allowed a few minutes for individual reading of the text followed by group discussion. For the two multi-page texts, participants were given the opportunity to scrutinise particular paragraphs, and then come together as a group to share their perspectives about the entire text. Sticky notes were provided to allow participants to record their impressions about any part of the text that particularly caught their interest.

Activity Three

Activity Three followed the same pattern as Activity Two and was focussed on the process of risk communication. Over an hour, participants explored expert text and imagery about community consultation and social engagement.

Participants were first asked to focus on a text and a diagram. The text was a three-page document describing a commercial company's approach to community engagement, and the second was a diagram containing both text and imagery created by the same company, and depicting stakeholder and community engagement. Following this, participants were asked to focus on two complex images comprising map overlays of the nearby RAAF base and environs. One map was about groundwater flows, the other about surface water flows and catchment area.

At the completion of Activity Three, all participants met together and undertook Activity Four.

Activity Four.

This activity aimed to continue the process begun in Activity One and draw out further responses to the idea of 'the expert'. All participants were asked to provide their perspective about experts during open dialogue and their spoken responses were both recorded digitally and immediately written on a large sheet of paper. It contained a circle to represent the domain of 'the expert' and was visible to everyone. The aim was the creation of a mind map of 'the expert', in a form suggested by Visschers et al. (2007) who created a diagram to represent a mental model of a particular risk. (Figure 1, p. 718). The paper sheet was collected and the recorded discussion was transcribed. This activity completed the focus group program.

A note on the selection of imagery

Imagery was selected using guidance provided by experienced researchers. Estrada and Davis (2015) provided guidance on image quality, referring to organising principles around composition, abstraction, colour, layers and refinement (p.141). Barnaud et al. (2013) provided guidance on the identification of image users, emphasising the need to identify target audiences and select suitable visual elements (p.14). Since the target audience comprised people with limited knowledge, experience or understanding of remediation, it was essential that text and imagery be selected with their information needs in mind. Image selection also took account of findings from the image survey provided in 7.5.2. in the thesis. These findings distinguish between delivery platform, image type and image content, and identify two overarching formats for image presentation: simple and complex. I define simple

images are those unembellished by any annotation, and for this inquiry, they refer to photos. I define complex images are those that align with Estrada and Davis (2015)'s classification. They "contain elaborate visual images, complex design elements, and unique formats" (p.145). This latter definition allows for the text-heavy diagrams which contain simple imagery.

I selected a mix of simple and complex imagery for the focus group. Three images were sourced from the image survey and four images were sourced from current documents about POPs land contamination, exposure and risk.

The text was selected to complement the images and to reflect the current state of risk communication about PFAS. Five texts were selected. Two texts were created by government and three texts were created by a private company contracted to the Australian Department of Defence. Two texts of these were in the form of the text-heavy diagrams mentioned above.

Focus Group
12 October 2019
Richmond Leisure and Learning Centre
9am-12 noon

PROGRAM

8.30-9am. Arrival and Welcome. K, J and L-E.

Get participants to fill out Consent Form: L-E and J.

Get participants to fill out Participant Details Form. L-E and J.

9 am- 9.15. Introduction. Kate H

Introductions.

The Project & the Focus Group

- **Activity 1. Quick test.** Think of an expert or experts that you have met and listened to. What is the first thought that comes to mind about them? Write it down.; one word is enough, or a couple if you wish L-E and J to hand out slips of paper & collect them

Divide into Group A and Group B. Two rooms available. Group A to the Dining Room and Group B to stay in the Lounge area

9.15-10.15. Activity 2. Exploring the content of experts' risk communication

In this activity, we explore your perspectives about how experts explain risks from PFAS land contamination.

Firstly, we will provide you with 5 images. We want you, over a period of 30 minutes, to look at them as a group, and describe what they mean to you, what they might make you feel or remember.

IMAGE 1. 5 minutes: The masked expert

IMAGE 2. 5 minutes: Green piled earth

IMAGE 3. 5minutes: A child crawling

IMAGE 4. 5 minutes: Groundwater Treatment Plant

IMAGE5. 5 minutes: Site figure with boundaries

Finalisation: 5 minutes

Secondly, we will provide you with 3 sets of text. We want you, over a period of 30 minutes, to read them and describe what they mean to you. What do they convey to you? For Texts 2 and 3, you can divide up the reading task by each reading a paragraph, and then come together to discuss their meaning [L-E and J to assist here if needed]

TEXT 1. 8 minutes: A Network graphic [from Dept. Defence's PFAS Investigation & Management Plan

TEXT 2. 8 minutes: *Enhealth* Guidance Statement

TEXT 3. 8 minutes: EPA Fact Sheet

Finalisation: 6 minutes

10.15-10.35. Break

10.35-11.35. Activity 3. Exploring the processes of risk communication

In this activity, we explore your perspectives about community consultation and social engagement

First we will provide you with 2 sets of text. We want you, over a period of 30 minutes, to read them as a group, and describe what they mean to you. What do they convey to you? For Text 4, you can divide up the reading task by each reading a paragraph and then come together to discuss their meaning

TEXT 4. 15 minutes: AECOM Community Engagement

TEXT 5. 15 minutes: Network graphic on stakeholder and community engagement

Then we will provide you with 2 images. They are maps. We want you as a group to look at them and pick out things that interest you, have relevance to your life and the community

IMAGE 6. 15 minutes Richmond RAAF Base & environs. Groundwater contours. [OMP]

IMAGE 7. 15 minutes Richmond RAAF Base & environs. Surface Water/catchment areas [PMAP]

11.35-noon. Final group activity and close

Open forum. Mind map creation on butchers' paper

Acknowledgement and thanks.

Focus Group Participants: Details								
Details	Participant (n=8/9) ¹³							
	1	2	3	4	5	6	7	8
Home location	Rhodes	Rhodes	Richmond	Kurrajong Heights	Cattai	Yarramundi	Yarramundi	Richmond
Own/rent	Own	Own	Own	Own	Rent	Rent	Rent	Own
Years resident in the area	53	56	30	36	23	25	25	3
Sex (M/F)	F	F	F	M	M	M	F	F
Age bracket	65-76	80	65-76	50-64	20-34	35-49	35-49	35-49

¹³ Participant 9 did not reply to the information request. This participant came late and did not respond to phone calls.

Occupation	Retired	Volunteer	Retired	Self-employed professional	Unemployed	Farmer	Farmer	Sustainability consultant
Club or group membership	Rhodes Community Committee	Concord Community Village	Richmond Club	Environment	Not current	No	No	Hawkesbury Environment Network
Personal Interests	Keeping fit	Reading, travel	Creative activities, reading, writing, gardening, walking	Sustainability, culture and personal development	Reading gardening, music, politics	Farming, fishing	Farming, fishing	Healthy living
Volunteer	Meals on Wheels	Meals on Wheels	Meals on Wheels, <i>Remakery</i>	Numerous	Not current	No	No	Hawkesbury Environment Network
Previous participation in community consultation	With remediation and developers	Rhodes remediation	Not that I can remember	Planning	Member of a cooperative for solar power	No	No	No

Appendix 3.3. Milestones Questionnaire.

THE RESEARCH PROJECT

*Integration Mechanisms in Risk Communication about the Selection of Remediation Design for Persistent Organic Pollutants: Bridging Content, Bridging Process and Perception Benefit.*¹⁴

RESEARCHER

Kate Hughes
Institute for Sustainable Futures
UTS

THE RESEARCH TOOL

In-Depth Interviews

WHAT IS THIS DOCUMENT

Milestones in Public Consciousness About Technologies, Processes and Products associated with Hazardous Chemicals and their Remediation.

Introduction

As part of the research project about expert to non-expert risk communication, I am exploring the psycho-social context of pollution and aim to get an insight into how experts understand it. For this reason, I am asking you to complete the questionnaire below. It comprises a list of events that came to the fore during my literature review. It is by no means an exhaustive list but aims to start a process of identifying key milestones in public consciousness about potentially polluting technologies, processes and products, and their remediation. The list of events deploys a NSW focus, framed within a national and global context.

Please tick a box to indicate their relevance.

On completion, you can also add other events that you consider important.

1961

Beginning of use of chemical defoliants in the Vietnam War. Includes *Agent Orange*.

Yes ☐ No ☐ Maybe ☐

1962

Anti-nausea drug thalidomide reported as a teratogen, prompting outrage and debate about corporate responsibility and unsafe products.

Yes ☐ No ☐ Maybe ☐

1963

The publication of *Silent Spring* by Rachael Carson draws international attention to the impact of the POP, DDT on wildlife reproduction.

Yes ☐ No ☐ Maybe ☐

1965

Discovery of Niigata Minamata Disease. Mercury pollution of a local marine environment in Japan is found to be the cause.

¹⁴ This is the original title of the dissertation. Approval to change to another title was sought and given by the Graduate Research School, UTS.

Yes ☐ No ☐ Maybe ☐

1968

Club of Rome formed to publicise environmental degradation, including by transboundary pollution.

Yes ☐ No ☐ Maybe ☐

1967

Use of chemical defoliants in the Vietnam War reaches its' peak. Includes use of *Agent Orange*, a mixture of 2,4,5-T, 2,4-D and aviation fuel.

Yes ☐ No ☐ Maybe ☐

1971

Australian Environment Council First delivers its first report on DDT.

Yes ☐ No ☐ Maybe ☐

Formation of the NSW State Pollution Control Commission (SPCC).

Yes ☐ No ☐ Maybe ☐

1972

Club of Rome publishes *The Limits to Growth*

Yes ☐ No ☐ Maybe ☐

Colour television established across all mass media networks.

Yes ☐ No ☐ Maybe ☐

Formation of the Australian Environment Council

Yes ☐ No ☐ Maybe ☐

1975

Australian Government introduces the Stock Residues and Chemicals Act to control the use of POPs insecticides in food products.

Yes ☐ No ☐ Maybe ☐

NSW Government establishes a temporary hazardous waste disposal site at Castlereagh in western Sydney.

Yes ☐ No ☐ Maybe ☐

1976

Industrial accident in Seveso, Italy leads to significant community exposure to 'dioxin' and extensive media coverage.

Yes ☐ No ☐ Maybe ☐

TCDD 2,3,7,8 is identified as the most hazardous form of 'dioxin'.

Yes ☐ No ☐ Maybe ☐

1978

US Government announces a federal health emergency at Love Canal, New York State, where an entire community was exposed to 'dioxin'.

Yes ☐ No ☐ Maybe ☐

Victorian Government inquiry into a cluster of birth defects in Yarram following public protests against use of 2,4,5-T for weed control.

Yes ☐ No ☐ Maybe ☐

1980

US Government enacts the 'Superfund' legislation (Comprehensive Environmental Response, Compensation, and Liability Act) to support contaminated site clean up.

Yes ☐ No ☐ Maybe ☐

1981

Australian Environment Council (AEC) announces the Interim Scheme for Notification and Assessment of Hazardous Chemicals.

Yes ☐ No ☐ Maybe ☐

Soil contamination in Lekkerkerk, Holland linked to human health risks.

Yes ☐ No ☐ Maybe ☐

1982

First report into hazardous waste tabled in the Australian Parliament.

Yes ☐ No ☐ Maybe ☐

The incinerator ship, "Vulcanus" destroys 4660 tons of liquid chemical wastes off the NSW coast.

Yes ☐ No ☐ Maybe ☐

Major nuclear accident at Three Mile Island in Pennsylvania, USA.

Yes ☐ No ☐ Maybe ☐

US Government acknowledges public health risk due to dioxin-contaminated soil at Times Beach, Missouri.

Yes ☐ No ☐ Maybe ☐

1983

U.N. General Assembly creates the World Commission on Environment and Development.

Yes ☐ No ☐ Maybe ☐

1984

United Nations publishes its' "Consolidated List of Products whose consumption and/or sale have been banned, withdrawn, severely restricted or not approved by governments". List includes POPs insecticides and pharmaceuticals.

Yes ☐ No ☐ Maybe ☐

Industrial accident at the Union Carbide chemical plant, Bhopal, India kills and injures tens of thousands of people.

Yes ☐ No ☐ Maybe ☐

1985

Promulgation of the NSW Environmentally Hazardous Chemicals Act.

Yes ☐ No ☐ Maybe ☐

Evatt Royal Commission into *Agent Orange*.

Yes ☐ No ☐ Maybe ☐

International NGO, Pesticide Action Network launches the Dirty Dozen Campaign about POPs pesticides.

Yes ☐ No ☐ Maybe ☐

1986

US Emergency Planning/Community Right To Know Act passed.

Yes ☐ No ☐ Maybe ☐

AEC releases national guidelines for the management of hazardous wastes.

Yes ☐ No ☐ Maybe ☐

Northern Territory Government proposes a high temperature incinerator for Tennant Creek to destroy Australia's hazardous waste stockpiles.

Yes ☐ No ☐ Maybe ☐

Exxon Valdez oil spill in Alaska and chemical spill on the Rhine River in Europe attract extensive international media coverage.

Yes ☐ No ☐ Maybe ☐

1987

Publication of *Our Common Future* by World Commission on Environment and Development. Known as The Brundtland Report.

Yes ☐ No ☐ Maybe ☐

Australian Government forms the Joint Task Force on Hazardous Waste with NSW and Victorian Governments.

Yes ☐ No ☐ Maybe ☐

Proposal to build a dioxin-generating pulp mill at Wesley Vale in Tasmania.

Yes ☐ No ☐ Maybe ☐

Detection of POPs insecticides in meat sold into US market leads to Australian beef export crisis.

Yes ☐ No ☐ Maybe ☐

Australian Agricultural and Veterinary Chemicals Council established to harmonise pesticide control at national level.

Yes ☐ No ☐ Maybe ☐

1989

Homebush site remediation project begins.

Yes ☐ No ☐ Maybe ☐

Wesley Vale pulp mill proposal abandoned.

Yes ☐ No ☐ Maybe ☐

1990

Joint Task Force recommends a high temperature incinerator be built in the NSW town of Corawa. Residents reject proposal.

Yes ☐ No ☐ Maybe ☐

Significant contamination identified at homes built on a former mining waste dump site at Kingston, a suburb of Brisbane.

Yes ☐ No ☐ Maybe ☐

Significant contamination identified at homes built of former wood treatment site at Martin Street in Armidale, NSW.

Yes ☐ No ☐ Maybe ☐

1991

Formation of the Independent Panel on Hazardous Waste.

Yes ☐ No ☐ Maybe ☐

SPCC posts signs warning people not to eat fish caught west of the Gladesville Bridge on the Parramatta River.

Yes ☐ No ☐ Maybe ☐

The Wingspread Statement of Consensus provides international scientific recognition of the impact of POPs on the endocrine system of all species studied.

Yes ☐ No ☐ Maybe ☐

1992

United Nations *Earth Summit* in Rio de Janeiro

Yes ☐ No ☐ Maybe ☐

NSW EPA created; replaces the State Pollution Control Commission

Yes ☐ No ☐ Maybe ☐

Australian Government ratifies the Basel Convention on the Control of Transboundary Movements of Hazardous Waste & their Disposal.

Yes ☐ No ☐ Maybe ☐

ANZECC/ NHMRC release Australian and New Zealand Guidelines for the assessment of contaminated sites.

Yes ☐ No ☐ Maybe ☐

1993

Sydney winds the rights to host the Year 2000 Summer Olympic Games at Homebush. "Green Guidelines" identify land remediation as a key deliverable.

Yes ☐ No ☐ Maybe ☐

1994

ANZECC release National Strategy for the management of scheduled waste.

Yes ☐ No ☐ Maybe ☐

National Environment Protection Council (NEPC) is created.

Yes ☐ No ☐ Maybe ☐

1995

Australian Government enforces total ban on cyclodiene insecticides and DDT. Other POPs pesticides continue to be used.

Yes ☐ No ☐ Maybe ☐

Master Plan for the development of Homebush Olympic site released, with broad-acre land remediation a key feature.

Yes ☐ No ☐ Maybe ☐

Full public access to the internet via Netscape.

Yes ☐ No ☐ Maybe ☐

1996

Community consultation about the HCB waste stockpile at Botany, NSW begins.

Yes ☐ No ☐ Maybe ☐

1997

'Dioxin' classified as a 'known human carcinogen' by the International Agency for Research on Cancer.

Yes ☐ No ☐ Maybe ☐

1998

Aarhus Protocol provides template for international POPs control framework.

Yes ☐ No ☐ Maybe ☐

NSW Government implements fishing bans for Sydney Harbour and tributaries.

Yes ☐ No ☐ Maybe ☐

Community consultation about the Homebush Olympic site remediation begins.

Yes ☐ No ☐ Maybe ☐

1999

Belgian 'dioxin affair' reveals food contamination by dioxin

Yes ☐ No ☐ Maybe ☐

Australian Government introduces the first National Environment Protection Measure (NEPM) for contaminated site assessment.

Yes ☐ No ☐ Maybe ☐

Armidale contaminated land case settled.

Yes ☐ No ☐ Maybe ☐

NSW EPA issue a licence to enable the destruction of POPs wastes at the Homebush Olympic site.

Yes ☐ No ☐ Maybe ☐

2000

World Health Organisation releases revised standard for dioxin residues in food, reducing the acceptable amount to one tenth of what it had been.

Yes ☐ No ☐ Maybe ☐

Homebush Olympic site remediation completed.

Yes ☐ No ☐ Maybe ☐

2001

United Nations Environment Program promulgates the Stockholm Convention on Persistent Organic Pollutants.

Yes ☐ No ☐ Maybe ☐

2002

Australian Government releases NEPM on Contaminated sites

Yes ☐ No ☐ Maybe ☐

Environment Protection and Heritage Council replaces ANZECC

Yes ☐ No ☐ Maybe ☐

2004

Australian Government ratifies the Stockholm Convention

Yes ☐ No ☐ Maybe ☐

2005

The United Nations launches "Globally Harmonized System (GHS) for the Classification and Labeling of Chemicals"

Yes ☐ No ☐ Maybe ☐

2013

The Australian Government introduces an amended National Environment Protection Measure (NEPM) about contaminated site assessment.

Yes ☐ No ☐ Maybe ☐

If you wish, you can add any other milestone that you think is important

Your participation will assist to add depth to the research

Thank You.

Kate Hughes

Doctoral Candidate

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Appendix 3.4. Key Terms Questionnaire.

THE RESEARCH PROJECT

*Integration Mechanisms in Risk Communication about the Selection of Remediation Design for Persistent Organic Pollutants:
Bridging Content, Bridging Process and Perception Benefit¹⁵*

RESEARCHER

Kate Hughes
Institute for Sustainable Futures
UTS

THE RESEARCH TOOL

In-Depth Interviews

WHAT IS THIS DOCUMENT

The meaning of technical terms used during expert to non-expert social engagement about pollution remediation

Introduction

As part of the research project about expert to non-expert risk communication, the meaning of some technical terms, as understood by different groups of people, is being explored.

How would you explain the following terms to non-experts? Imagine that you have been approached by a non-expert and asked to explain the meaning of a term 'on-the-spot'. In other words, please write down what comes to mind straight away, If you wish, you can add other terms to the list and provide an explanation of their meaning.

Density

Volatility

Kinetics

No-effect Levels

¹⁵ This is the original title of the dissertation. Approval to change to another title was sought and given by the Graduate Research School, UTS

A conservative value

Trigger Values

The weight-of-evidence approach

Contamination

Exposure

Exposure Pathway

Remediation

Mandated science

Transfer of risk

Upstream engagement

Grey literature

Stakeholder

Community/Communities

Risk Perception

Thank You. Your participation will add depth and meaning to the research process

Kate Hughes

Doctoral Candidate

Institute for Sustainable Futures, UTS

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Appendix 4.1. Measure of Acceptability of 74 Milestones by 12 Experts.

Measure of Acceptability of 74 Milestones by Experts					
n=12/18					
Date	Milestone	Accepted as Relevant	Provisional Acceptance	Rejected	No Response Recorded
17 Milestones: First time period: 1961-1978					
1961	Beginning of use of chemical defoliants in the Vietnam War Includes <i>Agent Orange</i>	6/12 [1,4,5,10,15,17]	3/12 [9,12,16]	3/12[6,7,18]	0/12
1962	The public learn that the anti-nausea drug, thalidomide is a teratogen	7/12 [1,4,5,6,7,10,15]	3/12 [12,17,18]	2/12 [9,16]	0/12
1963	Publication of <i>Silent Spring</i> by Rachael Carson	8/12 [4,5,6,7,9,10,16,17]	3/12 [1,15,12]	1/12 [18]	0/12
1965	Mercury identified as the cause of Minamata Disease	8/12 [1,4,5,6,7,9,10,16]	4/12 [15,12,17,18]	0/12	0/12
1968	Club of Rome formed to publicise environmental degradation	2/12 [1,10]	4/12 [5,7,15,12]	6/12[4,6,9,16,17,18]	0/12
1967	Peak use of defoliants in Vietnam War: Includes <i>Agent Orange</i>	8/12 [1,4,5,6,7,10,15,17]	3/12 [9,12,16]	1/12 [18]	0/12
1971	Australian Environment Council delivers first report on DDT. ¹⁶	4/12 [5,7,15,16]	4/12 [1,10,12,17]	4/12 [4,6,9,18]	0/12
1971	Formation of the NSW State Pollution Control Commission	7/12 [1,5,7,9,10,15,16]	2/12 [12,17]	3/12 [4,6,18]	0/12
1972	Club of Rome publishes <i>The Limits to Growth</i> .	3/12 [1,7,10]	5/12 [5,15,12,16,17]	3/12 [4,6,9]	1/12 [18]
1972	Colour television introduced	3/12 [4,6,7]	6/12 [5,10,12,15,16,18]	3/12 [1,9,17]	0/12
1972	Australian Environment Council formed ¹⁷	2/12 [1,7]	8/12 [5,9,10,12,15,16,17,18]	2/12 [4,6]	0/12
1975	Australian Stock Residues & Chemicals Act introduced to control use of POPs insecticides in food	6/12 [1,5,10,15,16,17]	2/12 [9,12]	4/12 [4,6,7,18]	0/12
1975	NSW Govt. establishes temporary hazardous waste disposal site in western Sydney	7/12 [1,5,6,7,9,15,17]	4/12 [10,12,16,18]	1/12 [4]	0/12
1976	Industrial accident in Seveso, Italy causes community exposure to dioxins	9/12 [1,4,5,6,7,9,10,15,16]	3/12 [12,17,18]	0/12	0/12
1976	TCDD 2,3,7,8 is identified as the most hazardous form of dioxin	6/12 [5,7,10,15,16,17]	4/12 [4,9,12,18]	2/12 [1,6]	0/12
1978	Federal health emergency declared at Love Canal, New York State due to community exposure to dioxins	10/12 [1,4,5,6,7,9,10,15,16,17]	2/12 [12,18]	0/12	0/12
1978	Victorian Government inquiry into birth defect cluster in Yarram after protests against use of 2,4,5-T for weed control	5/12 [1,7,9,16,17]	5/12 [5,10,12,15,18]	2/12 [4,6]	0/12
17 Milestones	Possible responses: x / 204	Sub-Total	100	66	37
					1

¹⁶ This milestone was not enacted by the Australian Environment Council. The Australian Academy of Science released this report in 1971 and its findings prompted the formation of the Council the following year.

¹⁷ As above in Footnote 1.

Date	Milestone	Accepted as Relevant	Provisional Acceptance	Rejected	No Response Recorded
40 Milestones. Second Time Period: 1980-1995					
1980	US Government enacts the 'Superfund' legislation (CERCLA) to support contaminated site clean up	6/12 [1,4,5,10,16,17]	5/12 [6,9,12,15,18]	1/12 [7]	
1981	Australian Environment Council announces the Interim Scheme for Notification and Assessment of Hazardous Chemicals	4/12 [1,5,10,17]	5/12 [9,12,15,16,18]	3/12 [4,6,7]	0/12
1981	Soil contamination in Lekkerkerk, Holland linked to human health risks	3/12 [1,7,16]	5/12 [5,10,12,15,17]	4/12 [4,6,9,18]	0/12
1982	First report into hazardous waste tabled in Australian Parliament	4/12 [1,5,10,17]	5/12 [9,12,15,16,18]	3/12 [4,6,7]	0/12
1982	Incinerator ship, "Vulcanus" destroys 4660 tons of liquid chemical wastes off the NSW coast	4/12 [1,5,7,17]	7/12 [6,9,10,12,15,16,18]	1/12 [4]	0/12
1982	Major nuclear accident at Three Mile Island in USA	8/12 [1,4,5,6,7,9,10,16]	2/12 [12,18]	2/12 [15,17]	0/12
1982	US Government acknowledges public health risk due to dioxin-contaminated soil at Times Beach, Missouri	4/12 [1,7,10,16]	6/12 [5,9,12,15,17,18]	2/12 [4,6]	0/12
1983	U.N. General Assembly creates the World Commission on Environment and Development	2/12 [1,10]	5/12 [9,12,15,16,17]	5/12 [4,5,6,7,18]	0/12
1984	UN publishes "Consolidated List of Products whose consumption and/or sale have been banned, withdrawn, severely restricted or not approved by governments". List includes POPs insecticides	9/12 [1,5,6,7,9,10,16,17,18]	2/12 [12,15]	1/12 [4]	0/12
1984	Industrial accident at the Union Carbide chemical plant, Bhopal, India kills and injures tens of thousands of people	11/12 [1,9,4,5,6,7,9,10,15,16,17,18]	1/12 [12]	0/12	0/12
1985	NSW Environmentally Hazardous Chemicals Act promulgated	6/12 [1,5,9,10,16,17]	4/12 [4,7,15,18]	1/12 [6]	1/12 [12]
1985	Evatt Royal Commission into <i>Agent Orange</i>	4/12 [1,7,9,10]	5/12 [5,15,16,17,18]	2/12 [4,6]	1/12 [12]
1985	Pesticide Action Network launches the <i>Dirty Dozen Campaign</i> about POPs pesticides	5/12 [7,9,10,16,17]	1,5,15,18,	4,6,	1/12 [12]
1986	US Emergency Planning/Community Right To Know Act passed.	2/12 [15,16]	8/12 [1,5,7,9,10,12,17,18]	2/12 [4,6]	0/12
1986	Australian Environment Council releases national guidelines for management of hazardous wastes.	5/12 [1,9,10,15,17]	3/12 [5,12,18]	3/12 [4,6,7]	1/12 [16]
1986	Northern Territory Government proposes high temperature incinerator to destroy Australia's hazardous waste stockpiles	3/12 [1,7,17]	6/12 [5,9,10,12,15,16]	3/12 [4,6,18]	0/12
1986	Exxon Valdez oil spill in Alaska and chemical spill on the Rhine River in Europe attract international media coverage	9/12 [1,4,5,6,7,9,10,16,18]	1/12 [12]	2/12 [15,17]	0/12
1987	Publication of <i>Our Common Future</i> by World Commission on Environment and Development	3/12 [4,9,10]	6/12 [1,5,12,15,16,17]	3/12 [6,7,18]	0/12
1987	Australian Government forms Joint Task Force on Hazardous Waste.	7/12 [1,4,5,9,10,15,17]	3/12 [12,16,18]	1/12 [6]	1/12 [7]
1987	Proposal for dioxin-generating pulp mill in Wesley Vale, Tasmania	5/12 [1,7,9,10,17]	5/12 [4,5,12,15,16]	2/12 [6,18]	0/12

Date	Milestone	Accepted as Relevant	Provisional Acceptance	Rejected	No Response Recorded	
1987	Detection of POPs insecticides in meat sold into US market leads to Australian beef export crisis	7/12 [1,5,7,9,10,16,18]	4/12 [6,12,15,17]	1/12 [4]	0/12	
1987	Australian Agricultural and Veterinary Chemicals Council established to harmonise pesticide control	3/12 [1,10,17]	5/12 [5,9,12,15,16]	4/12 [4,6,7,18]	0/12	
1989	Homebush site remediation project begins [Sydney] ¹⁸	9/12 [1,4,5,7,9,10,15,17,18]	2/12 [12,16]	1/12 [6]	0/12	
1989	Tasmania's Wesley Vale pulp mill proposal abandoned	4/12 [1,7,9,10]	5/12 [4,5,12,16,17]	3/12 [6,13,18]	0/12	
1990	Joint Task Force recommends a high temperature incinerator for NSW town of Corowa. Residents reject proposal	6/12 [1,5,7,9,10,17]	5/12 [6,12,15,16,18]	1/12 [4]	0/12	
1990	Contamination identified at homes built on a former mining waste dump site at Kingston in Brisbane, Queensland.	6/12 [7,9,10,15,16,18]	6/12 [1,4,5,6,12,17]	0/12	0/12	
1990	Contamination identified at homes built on former wood treatment site in Martin Street, Armidale, NSW	7/12 [1,4,7,9,13,16,18]	5/12 [5,6,10,12,17]	0/12	0/12	
1991	Formation of Independent Panel on Hazardous Waste [Aust.]	4/12 [1,10,15,17]	5/12 [5,9,12,16,18]	3/12 [4,6,7]	0/12	
1991	SPCC posts signs warning people not to eat fish caught west of the Gladesville Bridge on the Parramatta River, Sydney	8/12 [1,4,5,7,9,10,15,16]	4/12 [6,12,17,18]	0/12	0/12	
1991	Wingspread Statement of Consensus provides international scientific recognition of the impact of POPs on the endocrine system of all species studied	3/12 [7,10,17]	7/12 [1,5,9,12,15,16,18]	2/12 [4,6]	0/12	
1992	United Nations <i>Earth Summit</i> in Rio de Janiero	4/12 [1,4,7,10]	7/12 [5,9,12,15,16,17,18]	1/12 [6]	0/12	
1992	NSW EPA created	7/12 [1,4,5,7,13,16,17]	5/12 [6,9,10,12,18]			
1992	Australian Government ratifies Basel Convention on Control of Transboundary Movements of Hazardous Waste & their Disposal	5/12 [1,5,9,16,17]	5/12 [4,10,12,15,18]	2/12 [6,7]	0/12	
1992	ANZECC/ NHMRC release Australian and New Zealand Guidelines for the assessment of contaminated sites	9/12 [1,4,5,6,9,10,15,16,17]	2/12 [12,18]	1/12 [7]	0/12	
1993	Sydney wins hosting rights to Year 2000 Summer Olympic Games. "Green Guidelines" identify land remediation as a key deliverable	9/12 [1,4,7,9,10,15,16,17,18]	3/12 [5,6,12]	0/12	0/12	
1994	ANZECC release National Strategy for the Management of Scheduled Waste	5/12 [1,4,10,15,17]	5/12[5,9,12,16,18]	2/12 [6,7]	0/12	
1994	National Environment Protection Council created	6/12 [1,4,7,10,15,17]	5/12 [5,9,12,16,18]	1/12 [6]	0/12	
1995	Australian Government bans cyclodiene insecticides and DDT. Other POPs pesticides continue to be used in Australia	7/12 [5,7,9,10,16,17,18]	4/12 [1,6,12,13,]	1/12 [4]	0/12	
1995	Master Plan for the development of Homebush Olympic site released: includes broad-acre land remediation	9/12 [1,4,5,7,9,15,16,17,18]	3/12 [6,10,12]	0/12	0/12	
1995	Full public access to the internet via Netscape.	7/12 [4,7,9,10,15,16,18,]	2/12 [1,12]	2/12 [5,6,]	1/12 [17]	
40 Milestones	Possible responses: x /480	Sub-Total	229	177	68	6

¹⁸ Later referred to as the Homebush Olympic site

Date	Milestone	Accepted as Relevant	Provisional Acceptance	Rejected	No Response Recorded	
17 Milestones. Third Time Period: 1996-2013						
1996	Community consultation on HCB waste stockpile at Botany, NSW begins	9/12 [1,4,5,7,9,10,15,16,17]	2/12 [12,18]	1/12 [6]	0/12	
1997	'Dioxin classified as a 'known human carcinogen' by the IARC	10/12 [1,5,6,7,9,10,15,16,17,18]	2/12 [4,12]	0/12	0/12	
1998	Aarhus Protocol provides template for international POPs control framework	3/12 [1,16,17]	6/12 [5,9,10,12,13,18]	3/12 [4,6,7]		
1998	NSW Government implements fishing bans for Sydney Harbour and tributaries	9/12 [1,4,5,7,9,10,15,16,18]	3/12 [6,12,17]	0/12	0/12	
1998	Community consultation for Homebush Olympic site remediation begins	12/12 [1,4,5,6,7,9,10,12,15,16,17,18]	0/12	0/12	0/12	
1999	Belgian 'dioxin affair' reveals food contamination	3/12 [1,7,16]	7/12 [5,9,10,12,15,17,18]	2/12 [4,6]	0/12	
1999	Aust. Government introduces first National Environment Protection Measure for contaminated site assessment	9/12 [1,4,5,6,9,10,15,16,17]	2/12 [12,18]	1/12 [7]	0/12	
1999	Armidale, NSW contaminated land case settled	4/12 [4,7,9,16,]	7/12 [1,5,10,12,15,17,18]	1/12 [6]	0/12	
1999	NSW EPA issue licence for destruction of POPs wastes at Homebush Olympic site	10/12 [1,4,5,6,7,9,15,16,17,18]	2/12 [10,12]	0/12	0/12	
2000	WHO releases revised standard for dioxin residues in food, reducing the acceptable amount to one tenth of what it had been	6/12 [1,5,7,10,15,17]	5/12 [4,9,12,16,18]	1/12 [6,]	0/12	
2000	Homebush Olympic site remediation completed	10/12 [1,4,5,7,9,12,15,16,17,18]	2/12 [6,10]	0/12	0/12	
2001	UNEP promulgates Stockholm Convention on Persistent Organic Pollutants	8/12 [1,4,5,9,10,15,16,17]	3/12 [6,12,18]	1/12 [7]	0/12	
2002	Australian Government releases NEPM on Contaminated Sites	8/12 [1,4,5,9,10,15,16,17]	3/12 [6,12,18]	1/12 [7]	0/12	
2002	Environment Protection and Heritage Council replaces ANZECC	6/12 [1,4,7,9,15,16]	4/12 [5,12,17,18]	2/12 [6,10]	0/12	
2004	Australian Government ratifies the Stockholm Convention	8/12 [1,4,5,9,10,16,17,18]	2/12 [15,12]	2/12 [6,7]	0/12	
2005	UN launches "Globally Harmonized System (GHS) for the Classification and Labeling of Chemicals"	1/12 [15]	6/12 [1,10,12,16,17,18]	5/12 [4,5,6,7,9]	0/12	
2013	Australian Government introduces amended National Environment Protection Measure for contaminated site assessment	9/12 [1,4,5,6,9,12,15,16,17]	2/12 [10,18]	1/12 [7]	0/12	
17 milestones	Possible responses" x/204	Sub-Total	125	58	21	0

Appendix 7.1. Key Terms Questionnaire:

Definitions of ten terms from the bio-physical sciences.

Key Terms Questionnaire Ten Terms from the bio-physical sciences and their definitions		
Term and Area of Knowledge	Selected Definition	Source
Density <i>Properties of substances</i>	Mass per unit volume.	Ricketts et al. (2004).
Volatility <i>Properties of substances</i>	Readiness to vaporize or evaporate, tendency to be readily diffused or dissipated in the atmosphere, especially at ordinary temperatures.	OED (1989).
Kinetics <i>Properties of substances</i>	Producing or causing motion.	OED (1989).
A conservative value <i>Risk Assessment</i>	A measurement that reflects a cautious approach to evaluating and managing the uncertainties inherent in a risk assessment, that reduces the probability of harm occurring.	Commonwealth of Australia (2012).
Trigger Values <i>Risk Management</i>	Criteria set at or below an environmental standard limit used as triggers to review work practices that produce adverse environment impacts. Also known as action levels or action response levels.	Provided by Ventia Pty Ltd.
Weight-of-evidence approach <i>Risk Assessment</i>	Considerations in assessing the interpretation of published information about toxicity, quality of testing methods, size and power of study design, consistency of results across studies, and biological plausibility of exposure–response relationships and statistical associations.	Commonwealth of Australia (2012).
Contamination <i>Risk Assessment</i>	The condition of land or water where any chemical substance or waste has been added as a direct result or indirect result of human activity at above background level and represents, or potentially represents, an adverse health or environmental impact.	Commonwealth of Australia (2012).

Key Terms Questionnaire Ten Terms from the bio-physical sciences and their definitions		
Term and Area of Knowledge	Selected Definition	Source
Exposure <i>Risk Assessment</i>	Concentration or amount of a particular chemical that reaches a target organism, system, population or sub-population in a specific frequency for a defined duration.	Commonwealth of Australia (2016).
Exposure Pathway <i>Risk Assessment</i>	The way a chemical enters an organism after contact (e.g. by ingestion, inhalation or dermal absorption). A unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site.	Commonwealth of Australia (2012)
Remediation <i>Risk Management</i>	Cleanup or mitigation of pollution or of contamination of soil or water by various methods.	Commonwealth of Australia (2013a).

Appendix 8.1. Key Terms Questionnaire:

Definitions of seven terms from the social sciences.

Key Terms Questionnaire Seven Terms from the Social Sciences and their definitions		
Key Term	Selected Definition	Source
Mandated science	When scientific evidence is interpreted for the purpose of making policy recommendations.	Driedger et al. (2002, p. 790). Derived from Salter (1988).
Transfer of risk	A situation where the risk of exposure to contaminants is transferred from the site owner or remediator to the local community.	Researcher's definition
Upstream engagement	Social engagement that occurs prior to the mobilisation of a project.	Researcher's definition
Grey literature	Research literature that is either unpublished or has been published in non-commercial form.	University of New England (2019)
Stakeholder	One who has an interest in a project or who may be affected by it.	enHealth Council (2012, Glossary)
Community	Those individuals and/or groups residing in a locality where the site assessment is to be conducted and who may be affected by the assessment and/or possible site contamination physically...or non-physically.	Commonwealth of Australia (2013a,p.26)
Risk Perception	The subjective judgment that people make about the characteristics and severity of a risk.	Commonwealth of Australia (2013a, p.26)