# FROM LIABILITY TO VALUE: ANALYSIS OF LAND REMEDIATION DECISON-MAKING PROCESSES IN TWO AUSTRALIAN CITIES

Jason Prior, Aleta Lederwasch, Roel Plant
*Institute for Sustainable Futures, University of Technology Sydney, Sydney, Australia*

## INTRODUCTION

The remediation of contaminated urban land has potential to be used by a diversity of stakeholders as a means to create value out of a former liability. This paper explores how the remediation decision-making process (RDMP) for contaminated urban land in Australian cities currently creates outcomes that are valued in different ways by different stakeholders. Some readily recognised outcomes of RDMPs include the minimisation of environmental risk; the removal of blight on property; and the reduction of the impacts of hazardous substances on human health. This paper explores whether the outcomes sought and valued by stakeholders within RDMPs are potentially broader than this. We also explore how stakeholders' valuation of particular outcomes affects the overall dynamics of the RDMP. The paper builds on a larger body of research and practice that is seeking to understand the ways in which stakeholders engage with RDMPs. It seeks to contribute to a nascent body of research that explores how stakeholder values affect the outcomes of the RDMP. The call for such research originated in the remediation industry itself, which as a result of the emergence of the notions of 'green' and 'sustainable' remediation is seeking to understand how the RDMP can be used as a lever to attain the best possible outcomes for the diverse stakeholders involved (see e.g. Rio Tinto Alcan, 2009).

The study presented in this paper seeks to illuminate the relationship between stakeholder values and outcomes through the study of RDMPs associated with land development in two Australian cities. Through these two case studies, we aim to understand the range of outcomes that are valued by different stakeholders. In so doing, we seek to identify how the value that stakeholders attribute to particular outcomes affects and guides the overall dynamics of the RDMP. Before discussing and presenting the findings from the study we provide a brief overview of the changing nature of the RDMP over the past few decades. We also present an outline of the two selected case studies and the research methodology, including the theoretical framework and the data-collection procedures that were used.

## THE CHANGING NATURE OF RDMP

Over the past few decades RDMPs have changed significantly. For example, during the 1970s the most valued outcome from the RDMP was the least-cost remedial option (Hardisty, Ozdemiroglu, & Arch, 2008; Hausman, 2008). In the 1980s interest emerged into the ways in which technological innovations such as in-situ technologies could be used in the RDMP to attain a wider range of outcomes (Honders , Maas, & Gadella, 2003). In the 1990s the risk-based approach emerged in response to value that stakeholders placed on the notion that remediated land may be used for different future purposes, requiring 'fit for purpose' cleanup. This approach considered the nature and extent of the risk posed by chemicals in the air, soil and groundwater (Advisory Council on the Environment, 2006; Amendola; Luo, Catney, & Lerner, 2009; Mfodwo, 2006). In the late 2000s the broader concept of sustainability began to permeate the RDMP (Bardos & Nathanail, 2009; CRC-CARE, 2009; Nadebaum, 2008, 2009; Sarni, 2010; Simon, 2009; SuRF-UK, 2009; U.S. Sustainable Remediation Forum, 2009). Sustainability as an aspiration within RDMPs seeks to support sustainable outcomes by linking the RDMP to notions of intergenerational equity, economic viability and environmental protection (CRC-CARE, 2009 , p.6; Dixon, 2006, 2007; Doick, Pediaditi, Moffat, & Hutchings, 2009; Wernstedt, Alberini, Heberle, & Meyer, 2004). For example, 'green' technologies such as bioremediation were developed to address the growing value which stakeholders placed on achieving environmental outcomes in RDMPs (Efroymson, Nicolette, & Suter, 2004; Gochfeld, Burger, Friedlander, & Powers, 2007). Sustainable approaches to remediation also seek to integrate remediation with broader societal decision-making processes (e.g. regional planning). It is worth noting that to date these developments have not been uniform across countries. Fowler (2007, 2008) suggests that except in a few cases, a *de facto* risk-based approach is still the primary mode of operation in Australia.

These advances over the past few decades have also led to the involvement of an increasingly diverse array of stakeholders in RDMP, including: professionals such as auditors, council officers, consultants, remediation project managers, (Hage, Leroy, & Petersen, 2010; Reed, 2008; Thomas & David, 2000; Zsolnai, 2003) and

broader community members affected by the issues that are being addressed in the RDMP (Amendola; Edelstein, 2004; Harding, Hendriks, & Faruqi, 2009; McGee, 1998; Prior, Partridge, & Plant, 2009; Solomon, Katz, & Lovel, 2008).

Both of the case studies explored in this study involved a diverse array of professionals and engaged broadly with the affected communities in the surrounding area, and sought to include notions of sustainable remediation.

## CASE STUDIES OF LEADING PRACTICE RDMP IN TWO AUSTRALIAN CITIES

We conducted grounded case study research of leading practice in RDMP in two Australian cities. Case study research studies one or a few instances of a phenomenon – in our case RDMPs – in depth. Whilst knowledge is generated for the specific RDMP cases under investigation, the aims of case-based research are also to allow generalisation, within ranges of applicability, and to develop an understanding of causation that goes beyond the unique instances that are studied (Byrne, 2009). The two case studies were selected from a range of possible examples because they were identified as examples of leading practice in Australia (e.g. both case studies proactively engaged a broad range of community stakeholders in the RDMP). In addition there were practical reasons for selecting these cases, including ready access to participants for interviews and access to archival data. One case study was in Western Australia (referred to as the WA RDMP) and the other in New South Wales (referred to as the NSW RDMP). To protect the identity of those involved only generic information is provided on the two cases.

The WA RDMP is a small-scale soil and groundwater remediation project in an urban industrial area. The site is owned by a corporation which inherited the remediation issues as a result of a land purchase. The RDMP is focused on contamination that emanated from a single point, and resulted in a plume of contaminants in groundwater under adjacent properties, and which extended towards waterways. The NSW RDMP is made up of a series of interrelated RDMPs for various contaminants. Contamination associated with the NSW RDMP includes a groundwater plume, stores of chemicals, and various areas of contaminated soil. As with the WA RDMP, the groundwater plume associated with the NSW RDMP extends under adjoining residential properties. Both RDMPs have engaged extensively with government authorities and neighbouring communities.

## FRAMEWORK FOR VALUE ANALYSIS IN RDMPS

We use Institutional Analysis and Development (IAD), adapted from Ostrom and colleagues, as a theoretical framework to guide our analysis of RDMPs (see e.g. Ostrom, Gardner, & Walker, 2005). Figure 1 summarises this framework.

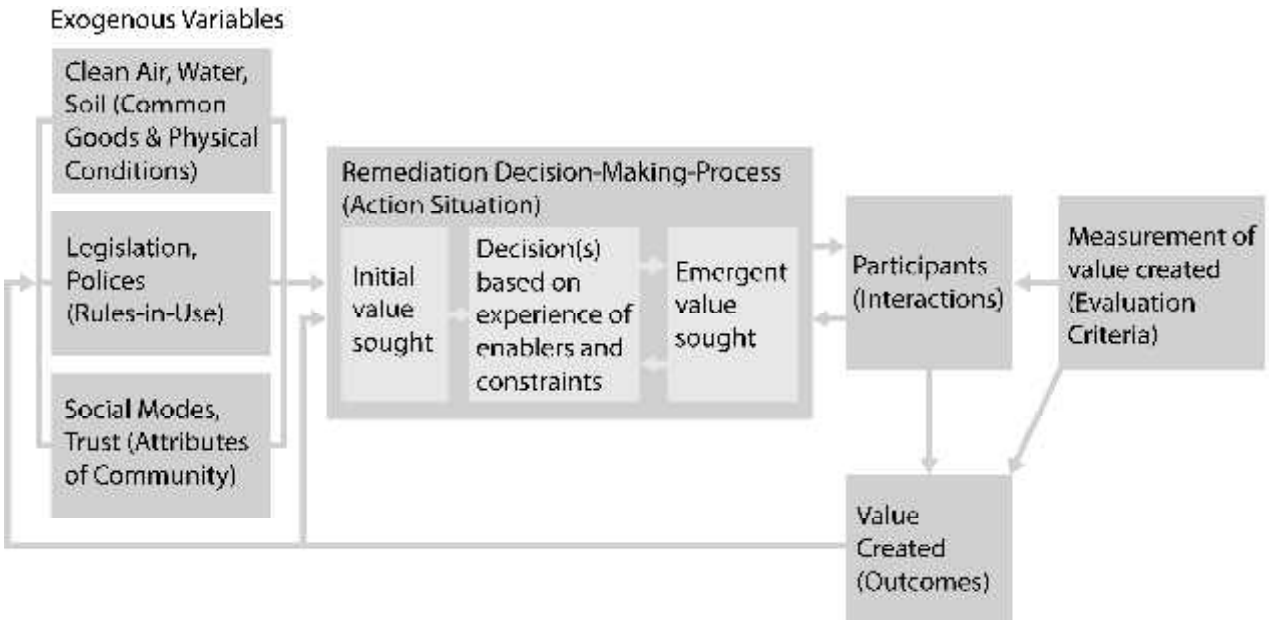

***Figure 1 - The Institutional Analysis and Development (IAD) Framework Adapted for Analysis of Participant Value in RDMP (Adapted from Ostrom, et al., 2005, p.13)***

The IAD framework provides a general set of variables for analysing the two RDMP case studies and as such the framework provides a language that permits systematic, comparative evaluation of how stakeholder value is related to the outcomes sought within the RDMP (Ostrom, 1990; Ostrom, Gardner, & Walker, 1994).

The IAD framework starts with the action situation as the unit of analysis and focus of investigation. In the case of this project the action situation is the RDMP – a "social space where [participants] … interact, exchange goods and services, engage in appropriation and provision activities, solve problems, or fight" (Ostrom, et al., 1994, p. 28). In this investigation we are particularly interested in what outcomes are valued by different stakeholders and how the value that stakeholders attribute to particular outcomes affects and guides the overall dynamics of the RDMP.

Action situations include "[participants] in positions who must decide among diverse actions in light of the information they possess about how actions are linked to the potential outcomes they seek" (Ostrom, et al., 1994, p.29). Outcomes, as Ostrom notes, are affected and guided by the participants' own valuations of possible outcomes (Ostrom, et al., 2005). In this study we explored the valuation of outcomes by participant types from both RDMP case studies – a remediator, an auditor, a consultant engineer, a neighbour, the owner of the site from where the contamination originated, and a local government representative.

As the IAD framework does not focus on value *per se*, we have sought to strengthen our theoretical framework by also utilising Keeney's work on value-focused thinking (Keeney, 1994; Keeney, McDaniels, & Ridge-Cooney, 1996). Keeney provides a way of making explicit the links between values and outcomes in decision-making (Keeney, 1994; Keeney, et al., 1996). Keeney defines values as follows:

> Values, as I use the term, are principles of evaluating the desirability of any possible alternative or consequence. They define all that you care about in a given decision situation. It is these values that are fundamentally important in any decision situation, more fundamental than alternatives, and they should be the driving force for our decision-making (Keeney, 1994, p.33)

The IAD framework allows the examination of participant behaviour in each RDMP to be explained in terms of a set of contextual factors: the nature of the good or physical/material condition; the attributes of the communities within which participants are embedded; and the rules that create incentives and constraints for certain actions. These three contextual factors are referred to as exogenous variables that action on and within the action situation – RDMP case studies. We only present findings on one of these factors – that is, rules-in-use. We explore how the values that stakeholders placed on particular outcomes within the RDMP affected the formal and informal rules (Ostrom, et al., 1994, p.38). The ability of participants to create value in the RDMP is dependent on formal and informal rules that structure remediation decision-making (Ostrom, et al., 2005). Ostrom (1990) notes how rule-in-use within such institutional settings as RDMPs are key to their operation, determining who is eligible to make decisions, what actions are allowed or constrained, what procedures must be followed, what information is or isn't provided, and what payoffs will be made between participants. As such, understanding rules-in-use provides an important starting point for understanding how RDMPs function. Rules-in-use are discussed in greater detail in the findings section of this paper.

The IAD framework is multi-dimensional and describes multiple levels of action: operational, collective choice, and constitutional choice (Kiser & Ostrom, 1982; Ostrom, et al., 1994, 2005). The RDMP case studies that are the focus of our study occur at the operational level. In Ostrom's framework the operational level involves the day-to-day activities that affect the world directly. In our case, these activities are to do with the remediation of contaminated sites. At the collective choice level decision makers create rules to impact on operation-level activities (e.g. remediation legislation), while at the constitutional level decision makers determine how much collective choice participants will be allowed and what the relationships between members of the collective choice body are (e.g., voting rules, agenda setting, power relationships) (Ostrom, 2008; Ostrom, et al., 1994, 2005).

**POPULATING THE FRAMEWORK**

To gather the information needed to apply Ostrom's IAD framework and Keeney's value-focused thinking to the two RDMP case studies, two data sets were collected through two methods: archival research of policies, legislation and other documentation relating to the case studies, and semi-structured in-depth interviews with the participants described above. The archival research was used at the outset of the project to provide the

researchers with the context for each RDMP case study, and after the interviews to reflect on key points made by participants about legislation, policies, planning instruments and other documents.

The semi-structured interview pro forma was designed to obtain information about the various components of the IAD framework, including the action situations (i.e. RDMPs), the outcomes sought from the RDMPs, participants' values and their interactions in the action situations, and the informal and formal rules-in-use that affected the action situations. Once the interview pro forma was designed it was piloted with a participant from one of the case studies. The feedback from this pilot was used to improve and clarify the instrument. Interview participants (six per case study) were selected from the archival research; participants who had extensive involvement in the RDMP case studies were preferred over those who had less involvement. The twelve respondents (six from each RDMP) included owners, regulators, auditors, neighbours, local council officers and remediation consultants.

The qualitative data in the interviews were thematically coded using NVIVO software. The thematic coding was used to identify those findings that could be generalised, within reason, for participant groups from the two case studies. The findings are presented and discussed below. Direct quotes identify types of participant only (e.g. auditor, neighbour, remediation consultant, local council representative) and for privacy reasons do not identify which RDMP case study they come from.

## RESULTS AND DISCUSSION

### Outcomes Valued by Participant Types in the RDMP Case Studies (Action Situation)

The research investigated the outcomes that were valued by the six different types of participants in the case studies. These outcomes valued by the six participant types were presented as statements of something that participants wanted to strive towards (i.e. an outcome), such as "the need for the remediation process to protect and minimise natural environmental risk" (see Table 1). As Keeney notes, such statements are "composed of three features: a decision context, an object, and a direction of preference" (Keeney, 1994, p.34). For example, in the statement "the remediation process needs to protect and minimise natural environmental risk" the decision context is the remediation process (this is implicit within all outcomes presented within Table 1), the object is the natural environmental, and the direction of preference is less environmental impact rather than more. Table 1 below lists the outcomes for the RDMP that different participants valued at the time of the interviews (the outcomes have been reduced to their most fundamental form).

*Temporal Nature of Value Sought*

All participant types indicated that the outcomes they valued evolved over the life of the RDMP (action situation). At the time of the interviews the WA RDMP had been going for almost a decade, whilst the NSW RDMP had been underway in various forms for almost two decades. Both RDMPs were still in progress when the research was conducted. All participants noted that at the onset of the RDMP (or when a participant initially became involved) they brought preconceived ideas of the outcomes they valued to the process. We call this '*initial value sought*' (see Table 1). Several participants noted how the outcomes they initially valued the most within the RDMP were framed by their 'particularistic' understanding.

All participant types also noted that the scope of the outcomes they valued shifted (most often expanded) as a result of their interactions in the RDMP. We call this '*emergent value sought*' (e.g. contributing to scientific knowledge, demonstrating innovation, enhancing environmental value as opposed to simply protecting it) (see Table 1). Participants noted how the emergent value sought resulted from new modes of understanding that were brought about by the unfolding of the interactions within the RDMP, and a shift away from the 'particularistic' understanding that framed their initial entry into the RDMP. As Snowden (2002 , p.101) notes, 'development in understanding' is generated through the ''flow'' created through "socialization, externalization, combination and internalization".

A significant number of the initial values sought by the participants related to things that the participants sought out of the RDMP, whilst the emergent values sought contained a large number of outcomes that related to the enhancement of the RDMP itself.

***Table 1 - Initial and Emergent Values Sought by Different Types of Participants in the RDMP Case Studies***

| | **Participant Type** | | | | | |
|---|---|---|---|---|---|---|
| **Initial Value Sought (Outcome)** | **Owner** | **Regulator** | **Auditor** | **Neighbour** | **Local Gov** | **Remediation Consultant** |
| VS1 - Minimising natural environmental risk | X | X | X | X | X | X |
| VS2 – Minimising human health risk | X | X | X | X | X | X |
| VS3 - Removing or neutralising the contamination so it poses no significant risk of harm | X | X | | X | X | X |
| VS4 – Fulfilling regulatory and contractual requirements | X | X | X | | | X |
| VS5 – Removing blight on land caused by the contamination | X | X | X | X | | |
| VS6 – Removing legacy issues | X | | | | | |
| VS7 – Maintaining and enhancing symbolic capital/ reputation | X | | | X | | X |
| VS8 – Extracting economic value from the remediated land via sale/ redevelopment | X | | | | | |
| VS9 – Achieving effective remediation with minimal costs | X | | X | | | X |
| **Emergent Value Sought (outcome)** | | | | | | |
| VS10 – Enhancing the natural environment | X | X | X | X | X | X |
| VS12 – Contributing to industry-wide scientific and technical knowledge | X | X | X | X | | X |
| VS13 – Building trusting relationships between participants | X | | X | X | X | |
| VS14 – Improving existing and future RDMPs | X | X | X | X | | |
| VS15 – Minimising levels of perceived risk held by community (increase sense of safety and security) | X | X | X | X | X | X |
| VS16 – Learning new perspectives and approaches to remediation | X | | | | | |
| VS17 – Empowering and building capacity in the community so they can engage with the RDMP | X | | X | X | X | |
| VS18 – Developing effective collaborations and communication between participants | X | X | X | X | X | X |

*Means Outcomes or Fundamental (Ends) Outcomes*

Table 1 shows that most of the outcomes were valued by a range of participant types, in some cases by all. For example, all participant types indicated that 'the remediation process should minimise human health risk' (VS2, Table1), and that 'the remediation process should minimise natural environmental risk' (VS1, Table1). Whilst all participant types valued certain outcomes, they did not place the same degree of value on all outcomes. This rendered simply listing the outcomes insufficient and brings out the need to highlight *how* each participant valued the different outcomes in different ways. To do this, we drew on the work of Keeney (Keeney, 1994, p.34) who distinguishes between what we will call 'means' outcomes and 'fundamental' outcomes (Keeney uses the term 'objective' instead of outcome, but given our use of Ostrom's IAD framework we will substitute outcomes for objectives). Fundamental outcomes are the ends that participant types value the most out of the RDMP, whilst 'means' outcomes are important to participant types in that they allow participant types to obtain fundamental outcomes (which have greater value for them). Whilst participant types may all value a particular outcome (e.g. minimise human health risk, see VS2, Table 1) from the RDMP, some may value it more fundamentally than others who may just see it as a means to an end. For example, the owners across both RDMP case studies said that the outcome they valued the most

from the RDMP was ‘Achieve effective remediation with minimal costs incurred’ (VS9, see Table 1). Other values that were important to the owners were:

> Protecting reputation has been probably [our] single most important driver to the remediation and the way it’s been carried out. (This equates to VS7 ‘Maintain and enhance companies symbolic capital/reputation’ see Table 1).
>
> The main aim is to eliminate the legacy issues; get the remediation over and done with so that it’s not on anyone’s agenda. Fix the problem and get away from it (this equates to VS6 ‘Management of the legacy issues’, see Table 1).

Whilst these three (fundamental) outcomes were highly valued by the owners, this did not mean that the owners did not value other outcomes such as ‘protecting humans by reducing health risk’, but that the other outcomes were only seen as a ‘means’ to the more fundamental outcomes they valued. Put another way, if the owners did not ‘minimise human health risk’ they would not be able to obtain the outcome they valued the most of enhancing their reputation and symbolic capital. The importance the owners attached to symbolic capital/reputation can be attributed to the fact that they are corporations. As Petrick, Scherer, Brodzinski, Quinnn, and Fall Ainina (1999) point out, corporations now trade in symbolic and reputational capital as well as economic capital. The value attributed to reputational and symbolic capital within RDMPs has been highlighted in other Australian remediation case studies, such as the one associated with the stockpile of hexachlorbenzene (HCB) at the Orica site in NSW (Benn & Jones, 2009).

In our case studies the auditors and remediators indicated that their most valued, and hence most fundamental, outcome was to fulfil regulatory and contractual requirements (see VS4 in Table 1). Departing from this the regulators and local government representatives in the RDMP case studies noted that the outcome that they most valued, and saw as their fundamental outcome, was to ‘protect humans by minimising health risk’ (VS2, Table 1). The neighbours who participated in the RDMP case studies also fundamentally valued ‘protect humans by minimising health risk’ (VS2, Table 1), but valued equally ‘removing blight on [their] land caused by the contamination’ (VS5, Table 1) as a fundamental outcome of the process. Whilst some outcomes listed in Table 1 were valued as fundamental and means outcomes by different participants, other outcomes such as ‘Improving the existing and future RDMPs’ (VS14, Table 1) were only valued as a means to more fundamental outcomes by all participants. For example, the owners that participated in the RDMP case studies pursued ‘improving the existing and future RDMP’ (VS14, in Table 1) as a means to improving the ‘cost effectiveness and efficiencies of future RDMP’ (VS9, Table 1) and also to demonstrating innovations that could be used to enhance their reputation (VS7, Table 1).

*Example of Means and Fundamental Outcomes Valued by a Participant Type*

The full range of ‘means outcomes’ and ‘fundamental outcomes’ was not mapped for each participant in the current paper. We present some examples of the means–fundamental (ends) outcomes linkages that the owners of the two RMDP case studies identified. These are based on the comments received from the owners in the two case studies and focus specifically on the fundamental outcome of enhanced reputation (VS7, Table 1), which was the most highly valued RDMP outcome sought by the two owners.

The owners at both sites noted how the ability to achieve the outcome of enhanced reputation, which they both valued the most, was supported through “effective collaboration and communication between participants” (VS18, Table 1). Effective collaboration in turn allowed the emergence of ‘increased trust amongst community and other participants’ (VS13, Table 1), which eventually led to the ‘enhancement of the reputation of the company’ (VS7, Table 1) because trust led them to be seen as good corporate citizens. This is demonstrated in part through the following owner response:

> The level of community engagement over the last eleven years has reduced community outrage down to one person ... they know what’s going on and they’ve seen significant amounts of improvement ... showing the community we actually care ... that’s a key factor.

Owners did not only seek to enhance their reputation with the broader community, but also in the remediation industry itself. This was apparent at both sites in that the owner acknowledged the significance of contributing to industry-wide scientific and technical knowledge as a ‘means’ of attaining an enhanced reputation in the sector.

*Clashes, Competing Interests, and Payoffs between Participants for the Outcomes they Valued*

In RDMPs the pursuit of particular outcomes that are valued by one participant type often comes at the expense of an outcome that is valued by another participant type. This was demonstrated in one of the RDMP case studies in this research, where the owner's interest in 'removing legacy issues' (VS6, Table 1) and 'remov[ing] or neutralis[ing] the contaminant' (VS3, Table 1), resulted in the discovery of an additional contaminant on a neighbour's property. This impeded the outcome that most participants valued, that is, the 'removal of blight on land caused by contamination' (VS5, Table 1), which significantly devalued the neighbouring land. This highlights the point made by the majority of participant types – owners, regulators, auditors, neighbours and remediation consultants – that sometimes when one participant achieved the outcomes that he/she valued this was done at the expense of the outcomes that other participants valued.

Whilst competing interests based on what the participants valued most played a part in determining the outcomes from the RDMP, participants often engaged in payoffs to achieve the outcomes they valued most. This most commonly occurred where a 'means' outcome valued by one participant led to the achievement of a fundamental outcome valued by another participant. For example, the site owners were aware they needed to address the neighbours' interest in 'minimising human health risk' (VS2, Table 1) to attain the 'enhanced reputation' outcome they valued (VS7, Table 1).

**Rules-in-Use within the RDMP (Action Situation)**

The level of influence that participant types had in the RDMP to achieve the outcomes they valued was dependent on a broad range of factors. In sections below we address one of these factors – the rules-in-use that framed the RDMP. This section discusses the rules-in-use in the RDMP case studies (action situation) as identified by the participants. These diverse rules guided and governed the way in which participant types were able to attain the outcomes they valued through the RDMP. These working rules, as Ostrom describes them (Ostrom, 1990), are used to determine who is eligible to make decisions in the RDMP, what actions are allowed or constrained, what procedures must be followed, what information is or isn't provided, and what payoffs will be made between participants. Ostrom identifies several types of working rules: boundary, position, payoff, information, scope and aggregation rules. We interrogate all these working rules here at the operational level – that is, we focus on the set of rules that affects day-to-day decisions in the RDMP case studies. We pay particular attention to how these rules-in-use relate to the value that participant types attribute to outcomes.

*Boundary Rules*

Boundary rules specify who is eligible to play a role, how the decisions about who is eligible to participate are made, and how an individual can enter or leave a role. The most commonly identified boundary rule for all participants was legislation. Participants noted that the legislation aligned with some of the key RDMP outcomes that they valued. For example, aspects of the *Protection of the Environment Operations Act 1997,* as expressed in the objective at s3, align with several of the outcomes detailed in Table 1 including: 'minimising natural environmental risk' (VSI, Table 1); 'Enhancing the natural environment' (VS10, Table 1); and 'Building trusting relationships between participants' (VS13, Table 1). Whilst some elements of the legislation supported the attainment of the outcomes that participants valued most, regulators and auditors indicated that the outcomes that participants sought from the RDMP were often constrained by legislation. The auditors provided the following reasons:

> The legislation constrains the way in which people can create value ... it sets the boundaries on the whole remediation and redevelopment process.
>
> In fairness to the regulators, it's got to be remembered that this is a very challenging site, which sometimes pushes the boundaries of what the legislation was created for.

The owners, auditors, and neighbours also noted that ambiguities within these pieces of legislation (boundary rules) often resulted in conflicts in the RDMP that constrained the ways in which some participants were able to obtain the outcomes they valued most from the process.

Whilst some boundary rules had the effect of limiting or constraining the outcomes that could be obtained, participants noted that boundaries of the RDMP were not fixed and often expanded to enable the creation of new outcomes. For example, one owner noted that this had often occurred in other RDMPs as a result of the sharing of technologies developed and lessons learned in cases where the new technologies created new opportunities.

*Position Rules*

In the RDMP, participants fulfilled/adopted particular 'slots' – that is they had roles that they played. These roles includes: auditors, council officer, remediation consultant etc. The nature of a position assigned to participants in the RDMP defined the 'standing' or role of the individual in that situation. Participants assigned to a position in the RDMP could choose from a set of authorised actions that their position allowed them at any particular stage in a decision process to do.

Whilst some of the value that participant types attributed to particular outcomes could be attributed to their personal values (it is not possible to exclude these from the process), the value they attributed to outcomes from the RDMP was more closely aligned with the position they filled. This was most apparent in the high value that the auditors and remediation consultants attributed to the fundamental outcome of 'fulfil[ling] regulatory and contractual requirements' (VS4, Table 1) within the RDMP. 'Fulfilling regulatory and contractual requirements' is an example of how the outcomes that participant types valued aligned with the different kinds of authority and responsibility that are attributed to the positions they occupy (e.g. uphold legislation). Similarly, the outcomes valued by participants from the EPA closely aligned with government legislation and related policy. This reveals that emerging values sought aligned with the objects of these formal rules.

The position rules that participants adopted within RDMP were subject to change over time, and such changes to position rules were often tied to the means outcomes that they sought through the RDMP. For example, the neighbours who participated in the RDMP valued 'improvements in existing and future RDMP' (VS14, Table 1) so as to create a stronger and more powerful position for future generations of affected community members/ neighbours to engage in RDMP. As one neighbour noted:

> For future generations, we believe that we've shown them that resident action doesn't have to be aggressive. Sometimes you have to be aggressive to get the initial attention you need, and when you get the attention you've got to work on getting the respect of people … I'm hoping that because of the hard yakka that we have put in, future generations won't have to have the same hard fight.

*Scope Rules*

The ways in which participants valued particular outcomes created a set of rules that defined the scope of the outcomes that the RDMP was able to generate. As such the participants' positions on what outcomes were valuable, or not, operated as *scope rules* (Ostrom, 1990). These define the set of outcome variables that must, must not, or may be achieved through the RDMP (action situation).

*Payoff Rules*

Whilst some participants attained the outcomes they valued most at the expense of other participants (as discussed earlier), some participant types also engaged in a series of payoffs with other participant types in an attempt to obtain the outcomes that they valued most. We call these *payoff rules*, and in doing so we extend the notion of payoff rules created by Ostrom (1994) to include the way in which participants establish payoffs between each other to enable them to obtain the outcomes they value most. A clear example of this type of payoff in the RDMP case studies was the one which occurred between a neighbour/community participant and an owner, where there was ongoing payoff between the high value that the owners placed on 'maintaining and enhancing symbolic capital/reputation' and the desire of the neighbours who valued 'protect humans by minimising health risk' (VS2, Table 1) and 'removal of blight on [their] land caused by the contamination' (VS5, Table 1). Sometimes these payoffs were easily generated, for example 'protect humans by minimising health risk' (VS2, Table 1) which was of high value to the neighbour, is a 'means outcome' that the owner understood was needed to obtain their most valued, 'fundamental outcome' of 'maintaining and enhancing the symbolic capital /reputation' of their company. In other situations payoffs were not so easily generated and often meant that one participant needed to temper or alter the outcome they valued.

Payoff rules as defined by Ostrom also occurred within the RDMP (Ostrom, 1990). Ostrom defines payoff rules as assigning rewards or sanctions to particular actions that have been taken, or to outcome variables when they reach a particular level. She defines three broad types of payoff rules that are used extensively: the imposition of a fine, the loss of appropriation rights, and incarceration. Often sanctions are graduated to match the severity of the incursion. This most often occurred in the RDMPs when participants sought to obtain the outcomes they valued the most at the expense of the outcomes that other participant types valued. For example, one owner noted how in an attempt to protect their company's reputation, they restricted the

flow of information to other participants, and that when this restriction of flow was exposed by the other participants sanctions were imposed on the company.

*Aggregation Rules*

Aggregation rules specify who has responsibility for an action at each particular point in an RDMP. In our RDMP case studies the ways in which participants valued particular outcomes contributed to the responsibility they assumed for particular actions. Shared values also provided a 'natural' reason for participants to aggregate together (or not aggregate together) about particular actions and a basis for determining who did or did not make a decision. For example, one neighbour/community participant clearly noted that they did not care to engage in the RDMP on the issue of 'how much the remediation process cost the owner' (VS9, Table 1) but sought to engage in the RDMP when it focused on actions and decisions that related to the outcomes that they valued such as 'protect humans by minimising health risk' (VS2, Table 1).

*Information Rules*

Information rules specify what information participants in particular roles within the RDMP must, must not or may communicate to other participants in particular roles at particular points in the decision process. Information rules also specify the language and form in which this communication is to take place.

All participant types noted that there were limited formal rules (e.g. legislation) within the RDMP that governed the flow of information, and that most information was exchanged through informal systems that relied almost entirely on voluntary exchange of information and on mutual monitoring. Given the informality surrounding relationships to information within the RDMP case studies, information flow within the process was described by participants as fragmented. This was reflected in the fact that most participants types – owner, regulator, auditor, neighbour, local council representative – identified 'lack of information flow with the RDMP' and 'poor communication between participants' as key constraints on the process. The identification by participants of these constraints led to participants attributing value to the emergent means outcome of 'Developing effective collaborations and communication between participants' (VS18, Table 1).

Participants in both RDMP case studies also highlighted the effect that the lack of information flow, and the limited opportunities for effective communication between stakeholders, had on the ability of the participants to achieve the outcomes they valued. For example, in one of the RDMP case studies poor communication between the community and other participants was believed to be causing mistrust and increased angst amongst community members, which led to a vast array of constraints, all with their own negative implications. For example poor communication led to increased levels of perceived risk (VS 18, Table 1), which significantly slowed the remediation process, causing increased costs and a reduced capacity to clean up the affected sites. Other impacts of poor communication that were identified by participants included missed opportunities for collaboration, and reduced opportunities for community building and establishing effective relationships for future RDMPs.

In both RDMP case studies, auditors and owners noted that they faced difficult decisions when providing other participants, particularly neighbours/community participants, with the information they required to make informed decisions. As one auditor explained:

> There's an awful lot of information … and a decision has to be made about how much to provide and when … as most companies, they release a certain amount that they think people really want to know and hang on to the rest unless someone asks for it … though often the community doesn't know what to ask for.

The informal rules developed by auditors and owners about the release of information helped decision making in some cases but in other cases it constrained decision making. Such filtering of information by the auditors and owners was often viewed as problematic by other participants who felt that they only had access to 'incomplete' information, and as a result had a less complete understanding, which impaired their ability to attain the outcomes that they valued most. As one neighbour noted:

> It's really significant ... if we're going to do major work there it's absolutely imperative that we get that data.

## MEASUREMENT OF VALUE CREATED (EVALUATION CITERIA)

The study reveals that currently there are only limited measures available for determining whether or not the full scope of outcomes which participants value in the RDMP are attained. This lack of evaluation limits our understanding of the effectiveness of RDMP for the participants that are involved. Such evaluative knowledge would enable insights into how current institutional arrangements restrict or promote outcomes. It would also enable recommendations to be made about a set of institutional arrangements for bringing about a greater scope of outcomes that are valued by participants. The case study findings suggest that a very limited selection of the full spectrum of outcomes is considered by formal evaluative criteria. At present, all types of participants indicated that measurement is limited to 'the use of performance metrics including contaminant concentration triggers', 'land valuation' and 'cost measures for the remediation process'. As the one auditor and one owner noted:

> We have cost measurements … simply time on the costs … but no real value measurement (Owner).
>
> They only have one measure of value and that is how much they realise at the end of it in terms of cash … they achieve by absolutely minimising every cost (Auditor).

## CONCLUDING REMARKS

In this paper we have sought to provide insights into the ways in which participant values operate within RDMPs. The findings provided a 'heuristic tool' that could bring about a better understanding of the ways in which participant values impact on and determine the outcomes of RDMP. They also show how such values help structure the complex decision-making situations associated with remediation. The findings from this study have direct relevance for many other RDMPs. One rationale for this statement is that many RDMPs share common characteristics that mandate some understanding of values. These characteristics include: the involvement of many interested participants; complex payoffs; various sources of uncertainty; and a wide variety of possible outcomes. Improving the ability to understand the value judgments that are made in such processes is an important task for those within the remediation and development industry. This improved understanding will help those who are seeking to better understand how diverse players engage with RDMPs and who want to understand what these players want out of such processes.

The paper has increased our understanding of the operation of value within RDMPs in several ways. First, through the use of Ostrom's IAD framework (Ostrom, 2008; Ostrom, et al., 1994, 2005), supplemented by Keeney's value-focused thinking (Keeney, 1994), the study has highlighted a methodological framework that can be used to understand the ways in which values operate within RDMPs. Neither of these established concepts was found to be wholly adequate for the examination of participant values within RDMP and as discussed they have both been adopted with some changes. At the same time the methods employed to examine values here were valuable in that they are systematic, logical, and transparent, and do not over-simplify issues – unlike standard cost-benefit analysis. Instead, the methods draw out the complex operation of participant values within RDMP. It is worth noting that the methods applied require considerable time, effort, and resources.

Second, the findings from the analysis provide a clear insight into the diversity of outcomes that are valued by participants, into the degree of value that participant types attached to particular outcomes, and into how some outcomes are only valued by particular participant types as means to more valued outcomes. In highlighting the ways in which value is attributed to outcomes by participants, we also highlight how in seeking the outcomes they value most, participants often achieve their valued outcome at the expense of the outcomes that are valued by other participants. Alternatively, participants may engage in a process of payoffs to attain the outcomes they value most.

Third, the findings associated with the analysis of informal and formal rules-in-use within the RDMP case studies suggest that the ways in which participants value particular outcomes affect, and are affected by, the boundaries and scope of the RDMP, the positions that they take within RDMP, the ways which they work together (aggregate) with others within the RDMP about actions, and how their ability to attain the outcomes they value are affected by the flow of information within the RDMP. Finally the findings discussed in this paper highlight the limited scope of formal evaluation that we apply to value within RDMP and how this limits our understanding of the full scope of value that such processes produce.

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