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Stakeholder Analysis for R&D Project Management:
A Systems Approach

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ABSTRACT: R&D management involves managing multiple stakeholders with conflicting stakes. This article proposes a systems approach to capture conflicting views of multiple stakeholders in controversial R&D projects. It is illustrated using a New Zealand case related to the use of 1080 chemical. Initially, the problem situation was structured systemically by analysing the behaviour of main variables related to 1080 use and by analysing stakeholders. Further, a participative systems model was developed using a group model building process. The analysis of the model revealed a set of feedback loops operating in the system identified as responsible for the complexity of the problem situation relating to 1080 use. The paper highlights some strategies suggested by the stakeholders to reduce conflict.

Keywords: Project Management, Systems Thinking, Stakeholder Analysis

1. INTRODUCTION

R&D projects can affect many stakeholders, representing economic, environmental and societal interests, with the potential for intense conflict between them (Hall & Martin, 2005). Some R&D projects can become controversial, disruptive and radical, based on the variance in interests and perspectives amongst different stakeholders (Tipping et al., 1995). The execution of such projects can be difficult as they affect multiple stakeholders (Elias et al., 2002) and they have the ability to influence the project (Freeman, 1984).

A New Zealand case of a controversial R&D project is the use of 1080 for pest management. 1080 is a chemical that is used both in ground and aerial pest management operations to protect New Zealand’s flora and fauna. The use of 1080 is controversial with extremely polarised views in New Zealand involving several stakeholders (PCE, 2000). Whilst the supporters of 1080 use claim that they have tried to address the problems of those stakeholders against it, the controversy is still apparent in the media (Wilson, 2012).

One of the problems faced by the organisations responsible for managing such controversial R&D projects is the lack of practical methodological frameworks, helpful in addressing and acknowledging the concerns multiple stakeholders. A review of R&D management literature also found the scope for more methodological illustrations to develop a shared mental model of conflicting stakeholders. Therefore in this article, we propose a methodological framework based on
systems thinking to develop a shared mental model of multiple stakeholders in a controversial R&D project. This approach is illustrated using the New Zealand case study of 1080 use.

2. A REVIEW OF STAKEHOLDER CONCEPT IN R&D MANAGEMENT LITERATURE
A review of R&D management literature found that the stakeholder concept was incorporated in it as a few different literature streams. R&D Management literature acknowledged the basic contention of stakeholder management that R&D projects involve multiple stakeholders with conflicting stakes, (Elias et al.; Prell et al., 2009). It also accepts that many new R&D projects failed as R&D project management did not take into account the viewpoints of multiple stakeholders (Bryson, 2004).

A landmark book in stakeholder management belongs to (Freeman, 1984), in which he defines stakeholders as any group or individual who can affect or is affected by the achievement of a firm’s objectives. He developed a stakeholder map capturing the dyadic relationship between the stakeholders and a firm. His view is also supported by other authors who define stakeholders as those who can influence or be influenced by an organisation or a project (Achterkamp & Vos, 2007). Freeman’s stakeholder management approach provides a structured approach for analysing stakeholders using three levels of analysis, namely, rational, process and transactional (Elias et al., 2002). In 2003, Freeman refined the original stakeholder map to encompass an increased understanding of the effects of prominent internal and external stakeholders (Fassin, 2009). In their latest book, Freeman et al. (2010) have reviewed and critiqued stakeholder theory, over the last thirty years, in relation to established business theories like Porter’s five forces and to growing trends like corporate social responsibility (Freeman et al., 2010). They have also proposed a new view of stakeholder theory, called stakeholder capitalism, where stakeholders drive business through the principles of stakeholder cooperation, stakeholder engagement, stakeholder responsibility, complexity, continuous creation and emergent competition (Freeman et al., 2010).

An important aspect that contributes to the complexity in managing stakeholders is their changing positions, interests and importance over time. Mitchell et al. (1997) explained this dynamics using a stakeholder typology model where the salience of stakeholders change when they possess or dispossess three attributes, namely, power, legitimacy and urgency. This model was found useful in understanding the relative positions of stakeholders in an R&D project. Some authors also found it
helpful in prioritising powerful stakeholders over the less powerful stakeholders in R&D projects
(Fassin, 2009; Elias et al., 2002)

Elias et al. (2002) conducted a comprehensive review of stakeholder literature by developing a
literature map of the evolution of stakeholder concept in management literature from 1963 to 2002.
They also developed a methodological framework for analysing stakeholders in R&D projects based
on Freeman (1984) and Mitchell et al. (1997). They illustrated this framework by applying it to a New
Zealand road pricing R&D project using an eight step process (Elias et al., 2002).

Since the literature review in (Elias et al., 2002), stakeholder concept in R&D management
literature has followed some interesting themes. In particular, this review also found another stream of
literature involving stakeholders in controversial and radical R&D projects. Davenport & Leitch have
published a number of articles on a controversial genetic engineering (GE) R&D project in New
Zealand (Davenport & Leitch, 2005; Davenport & Leitch, 2006; Davenport & Leitch, 2009). They
identified multiple stakeholders in this project, each with valid but differing perspectives to GE
(Davenport & Leitch, 2009). Whilst they found a framework for generating participation in a debate
forum, unfortunately the engagement process of the project regulators (ERMA) failed in engaging the
silent majority of the public Zealand (Davenport & Leitch, 2005; Davenport & Leitch, 2006).

In another work on radical R&D projects, Hall & Martin (2005) analysed stakeholders,
recognising that it was crucial for radical R&D projects as they may have widespread, often
controversial, social and environmental implications. They analysed the stakeholders of an R&D
project related to Monsanto’s development of agricultural biotechnology, where Monsanto was able to
satisfy regulatory demand and most stakeholders in the value chain but met disruption from secondary
stakeholders. Their analysis found that stakeholder perceptions could not be appeased without
provoking others (Hall & Martin, 2005). In addition, Elias et al. (2002) analysed the stakeholders of a
controversial R&D road pricing project in New Zealand. They found that the stakeholders can change
their positions over time in controversial R&D projects.

To summarise, R&D management literature has provided cases and examples of controversial
R&D projects. It also acknowledges the difficulty of managing stakeholders in such projects as they
affect multiple stakeholders with conflicting stakes, which change over time. However, literature
related to methodological approaches for managing such conflicts and for developing an accommodation amongst conflicting stakeholders is limited in the R&D management literature.

3. BACKGROUND OF THE 1080 CASE

Possums, rats and stoats were introduced to the predator-less environment of New Zealand in the early-European settlement of the country. Their populations have now grown, uninhibited, to a pest status with their vast numbers eating young birds and destroying New Zealand’s forest (PCE, 1994; PCE, 2000). 1080 is a chemical that is used, both in ground and aerial operations, as a part of pest management since the 1950s (PCE, 2000). The 1080 project management has evolved from possum hunting and trapping activities, to use of a variety of different pest management chemicals and chemical formulations that are suited to use in New Zealand’s rugged landscape, to researching alternatives based on public complaints and controversy surrounding 1080 use (PCE, 2011)

Following public complaints about the inhumane deaths of non-target animals, the Parliamentary Commissioner for the Environment (PCE) started reviewing 1080 use in 1994 (PCE, 1994; PCE, 1998). In 2000, the PCE used reference groups to research the impacts of 1080, identifying, for example, scientific mistrust by the public. In 2007, Environmental Risk Management Authority (ERMA) reviewed health and safety of 1080 in relation to public submissions (ERMA, 2007). In 2011, the PCE compared 1080 against other pest management options (PCE, 2011).

The Animal Health Board (AHB) and the Department of Conservation (DOC), who are responsible for these operations, both agree that 1080 is the most effective pest management option available at the moment (PCE, 2011). AHB use 1080 to eradicate possum-originating bovine tuberculosis (Tb) infecting cattle, which affects NZ’s exports in the long term (AHB, 2011). DOC use 1080 to eradicate possums, stoats, and rats to prevent them from destroying New Zealand’s native flora and fauna, and to protect New Zealand’s tourism image (Green, 2004). Both AHB and DOC get more confident when they see the positive results of 1080 use, resulting in more actual use of 1080.

On the other side, there are stakeholders who oppose 1080 use. They include independent groups, like the Deerstalkers Association, either affected directly through reduced deer hunting numbers (from secondary 1080 poisoning), or emotionally through having personally seen 1080’s
inhumane destruction of animals (Wilson, 2012). These stakeholders utilise media to get their points heard and regularly keep 1080 use exposed to the public.

Whilst regulators and accepters of 1080 have tried to address and acknowledge, the problems of those against 1080 use, the controversy is still apparent in the media. The level of conflict between these stakeholders is on the rise (Watson, 2010). But, there has been a clear lack of a methodological framework for the likes of DOC and AHB to address and acknowledge the concerns of the multiple stakeholders in relation to this controversial project.

4. Methodological Framework

The methodological framework used in this study is based on Systems Thinking and Modelling (Maani and Cavana, 2007), which based on the system dynamics approach. The framework used in this study consists of two phases, problem structuring and group model building (Table 1). [Insert Table 1 about here]

In the first phase, an attempt was used to structure the problem systemically. For this, first a ‘Behaviour over time’ (BOT) graph was developed. This was followed by a systematic stakeholder analysis. In the second phase, a process called group model building (Vennix, 1997) was employed. Group model building is a process in which team members exchange the perceptions of a problem and explore such questions as what exactly is the problem we face? What might be its underlying causes? How can the problem be effectively tackled? Among the different methods available for group model building, this study used hexagons for systems thinking, drawing on Hodgson’s (1994) use of hexagons for issue conceptualisation and Kreutzer’s FASTbreakTM process (Kreutzer, 1995) using hexagons to develop causal loop diagrams. Due to the complexity and controversial nature of the 1080 project, this methodological approach was deemed suitable for capturing the conflicting stakes of stakeholders and also for developing a shared mental model of these stakeholders.

4.1 Problem Structuring

The first part of problem structuring involved the development of a BOT chart, a tool used in systems thinking (Figure 1). A BOT graph shows how the key variables in a system change over time (Maani and Cavana, 2007). Information for the development of this BOT graph was collected
through preliminary interviews with nine key stakeholders representing regulators, operators, media, anti- and pro 1080 groups. Secondary data (PCE, 2011) was also collected for this purpose.

The BOT graph for the 1080 project shows that the amount of 1080 used per hectare is decreasing over time, with pest/possum population numbers and Tb infected herd numbers dropping (AHB, 2011; PCE, 2011). It also shows an increase in the native bird population and native species (PCE, 2011). However, the stakeholder conflict between anti-1080 and pro-1080 stakeholders is still present and growing (Davenport & Leitch, 2006).

The second part of the problem structuring involved the identification and analysis of the stakeholders related to the problem situation. Based on Elias et al. (2002), an eight step stakeholder analysis method was applied to the 1080 problem. The steps included (i) developing a generic stakeholder map of the problem, (ii) preparing a chart of the specific stakeholders, (iii) identifying the stakes of stakeholders, (iv) preparing a power versus stake grid, (v) conducting a process level stakeholder analysis, (vi) conducting a transactional level analysis, (vii) determining the stakeholder management capability of the R&D problem, and (viii) analysing the dynamics of stakeholders. A stakeholder map developed in this analysis is shown in figure 2. Discussion of all the eight steps is not included since it is beyond the scope of this article. It is worth mentioning that the application of these eight steps helped in gaining a better understanding about the different stakeholders involved in the 1080 project and their conflicting stakes. [Insert Figure 2: about here]

4.2 Group Model Building

In the second phase of this methodological framework, eight stakeholders were brought together to participate in a group model building session. The group model building exercises allowed the stakeholders to voice their individual perceptions about the project. This exercise also helped them to develop a shared mental model of their perceptions as a group.

Despite the controversy surrounding the 1080 project, at least one stakeholder representative from most of the stakeholder groups included in the stakeholder map (Figure 2) participated in the group model building exercise. Four steps were involved in the group model building exercise,
4.2.1 Hexagon Generation

To start the group model building session an organising question, “what are the factors involved in the 1080 project?” was posed to the stakeholders. Each participant responded to this question, voicing their perception. When they did so, it was written on to a hexagonally shaped post-it note and attached to the wall. The group model building session used several rounds of hexagon generation and a total of 52 hexagons were generated by the participants.

4.2.2 Cluster Formation

As the second step in group model building, participants were asked to cluster the hexagons they generated into groups and title them. As a result of this step, seven clusters were formed with the titles, stakeholder perception, decision making process, analysis of alternatives, operational consideration, technical research on 1080, research process and drivers for use. An example of a cluster is shown in Figure 3. [Insert Figure 3 about here]

4.2.3 Variable Identification

As the third step, participants were asked to identify measurable variables for each cluster. Participants were able to identify 2-3 variables for each cluster and the facilitator wrote them onto a new hexagon in different colour and placed it near the associated cluster. The variables developed during the session include amount of media attention, level of stakeholder conflict, number of resource consents for pest control, number of appeals against resource consents for pest control, number of public meetings about 1080, amount of funding for research alternatives, 1080 use per hectare, number of safety incidents (animal and human), number of TB infected herds, number of peer reviewed articles on 1080 research, amount of funding for research, amount of media attention, number of possums/pests, number of TB infected herds and amount of affected land.

4.2.4 Causal Loop Model

As the final step, the stakeholders tried to establish the links between variables identified in step 3. They first identified two variables that were related and provided a directed arrow between each pair
of related variables. To generate a directed arrow, they placed a positive (+) sign near the head of the arrow if an increase (or decrease) in a variable at the tail of an arrow caused a corresponding increase (or decrease) in a variable at the head of the arrow. If an increase in the causal variable caused a decrease in the affected variable, a negative (-) sign was placed near the head of the arrow. An initial version of the causal loop diagram was thus developed. At the end of the group model building exercise, a general agreement that this model represented their shared view was obtained from the stakeholders who participated in this exercise. This diagram was later refined by the facilitators and is presented in Figure 4. [Insert Figure 4 about here]

5. ANALYSIS OF THE CAUSAL LOOP MODEL

The Causal Loop Model was analysed to identify and understand the feedback loops operating in the system. Feedback loops can be reinforcing/positive or balancing/ negative (Sterman, 2000). An analysis of the causal loop diagram identified five reinforcing loops and three balancing loops operating in this system. The behaviour of the system, as captured in the BOT graph (Figure 1), can be explained using these eight feedback loops.

5.1 Reinforcing Loop 1: Possum/Pest Loop

A good place to start this analysis is the use of 1080 in New Zealand. When the use of 1080 per hectare increases, the number of possums and pests will start decreasing. This positive result will boost the confidence of using 1080 as an effective pest control mechanism, resulting in more 1080 use. This forms the first feedback loop, named ‘possum/pest loop’, which is technically a reinforcing/positive feedback loop. It is worth noting at this stage that it is not the only positive feedback loop operating in this system.

To explain this loop further, possums were introduced as a species to New Zealand, but have increased to a level where they are harming the New Zealand natural environment. 1080 as a form of pest control was used from the 1950s, since it was deemed suitable for the rugged New Zealand landscape.

It was found that 1080 use per hectare results in a decrease in the number of possums/pests, anywhere between 75-100% (PCE, 2011). 1080 is used in a series of operations, over a long period
of time, to destroy possum and pests, and these operations occur regularly as 1080 does not completely eradicate possum and pests.

5.2 Reinforcing Loop 2: Tb-infected Herd Loop

When the numbers of possums/pests starts decreasing due to the 1080 use, the number of Tb infected herds also decreases, as possums are known vectors of Tb infection to herds. The Animal Health Board (AHB) in New Zealand is committed to the eradication of Tb infected herds, and this positive result will further boost their confidence to use 1080. So, AHB continues to use more 1080 per hectare resulting in the reduction of Tb-infected herd numbers in New Zealand (AHB, 2011). This forms the second feedback loop, which is another reinforcing/positive feedback loop, named ‘Tb-infected herd loop’. A decrease in the number of Tb infected herd numbers is a positive outcome for both the Animal Health Board and New Zealand cattle exports.

5.3 Reinforcing Loop 3: Affected Land Loop

Possums and other pests can affect the land as they destruct New Zealand’s native flora and fauna. This is a concern for New Zealand’s Department of Conservation (DOC), as it is required to protect the natural heritage of New Zealand. When the number of possums and pests diminish as a result of 1080 use, the amount of land affected by them also starts decreasing. This is good news for DOC and their confidence in using 1080 will improve resulting in more actual use of 1080 per hectare. This is the third loop which is also a positive feedback loop, termed ‘affected land loop’. This reduction in affected land is a positive outcome for DOC and New Zealand tourism.

5.4 Reinforcing Loop 4: Birds/Native Species Loop

In the process of affecting the land, possums and pests impact on the birds and native species of New Zealand. Possums and pests eat bird eggs and chicks and also attack the insects and trees decreasing the native species. This is also a concern for the Department of Conservation in New Zealand. In the Causal Loop Model, when the 1080 use per hectare increases, the number of possums and pests deceases, resulting in an increase in bird population and also the native species in New Zealand. An increase in the amount of native species means a reduction in the amount of affected land. Such a positive result to the bird population, native species and affected will land will once again boost the
confidence of using 1080, resulting in more actual use of 1080 per hectare. This the fourth positive feedback loop and is named ‘birds/native species loop’.

These first four loops operating in the system illustrate only one side of the coin in case of the 1080 project. There are however, a number of other feedback loops operating in the system, responsible for the complex behaviour of the system illustrated in the BOT graph (Figure 1).

5.5 Reinforcing Loop 5: Research Loop

The group model building session identified two clusters involving the research process of 1080 and its alternatives. Public safety concerns have warranted research to validate 1080 use as well as to review new alternatives to 1080. There is a recognised public mistrust in science when it comes to 1080 (PCE, 2011).

In the Causal Loop Model, 1080 use during the years have led to an increase in the amount of funding available to conduct research on 1080 as well as on other alternatives of 1080. More research in this area will result in an increase in the number of research articles published about 1080 and alternatives, further increasing the chances of finding a possible alternative for 1080. If an alternative to 1080 were found, most of the stakeholder concerns about 1080 could be addressed, minimising the level of conflict between different stakeholders. This will also reduce the level of government intervention required since even DOC and AHB agree that 1080 is, at present, the best tool in the pest control toolbox until an alternative is available (PCE, 2011). When authentic alternatives are available, the use of 1080 can come down. This is the fifth positive loop, termed ‘research loop’.

5.6 Balancing Loop 1: Deer Hunters Loop

Deer hunters are a group of powerful stakeholders in this controversial project. The ability of deer hunters to hunt in recreational areas is impacted by the use of 1080. These recreational areas tend to be areas of affected land. An increase in the amount of 1080 use reduces the number of sites available for deer hunting, as 1080 operations restrict public usage for safety reasons. When deer hunters are unable to hunt, they indulge in protest actions against 1080. Any action against 1080 increases the amount of media attention. An increase in media coverage on 1080 increases the amount of stakeholder conflict as seen in local protests and letters to the editor. This situation in turn
demands government intervention to decrease the amount of 1080, through regulatory controls and
budget constraints. This completes the first negative or balancing, named ‘deer hunters loop’.

5.7 Balancing loop 2: Decision Making Process Loop
The group model building session identified concerns about the decision making process in 1080
operations. As 1080 is a chemical, there is a regulatory requirement for resource consents when it is
used. When 1080 use increases there is an increase in the number of resource consent applications.
Part of the resource consent will see an increase in the number of public meetings about 1080
operations. Due to the public concerns, and the feeling by some stakeholders that they are not being
heard, there will be an increase in appeals against 1080 resource consent. This situation results in a
low level of transactional effectiveness with stakeholders in the system. A low level of
transactional effectiveness leads to increasing levels of stakeholder conflict, which in turn demands
government intervention to reduce the amount of 1080 used. This loop is the second negative or
balancing loop in this system, named ‘decision making process loop’.

5.8 Balancing Loop 3: Safety Loop
Public safety is another important factor that affects the 1080 project. It is concerning for many in
the community to think of a poison being aerially dropped and how that is controlled. An increased
amount of 1080 used results in an increase in the amount of land and water ‘poisoned’ with 1080.
When such land and water poisoning increases, the potential for safety related accidents also
increases, including human operational safety accidents and secondary poisoning of animals like
dogs and deer. Any safety incidents surrounding 1080 amplifies media attention. An increase in
media coverage of safety accidents increases the level of stakeholder conflict, which can in turn
encourage the government to intervene and reduce 1080 use. This loop is named ‘safety loop’.

The three balancing loops relating to deer hunters, decision making process and safety
highlights the opposite side of the coin in case of the 1080 project. Structurally, these three loops are
responsible for the increasing levels of stakeholder conflict in this R&D project. The research loop is
also unable to arrest the rising levels of this conflict since an authentic alternative to 1080 has not yet
been found. Thus, the behaviour over time chart in figure 1 can be explained using the eight feedback
loops in the causal loop model. In other words, the interactions of these loops explain the complex problem situation presented in the BOT chart.

In summary, the group model building enabled different stakeholders within the 1080 R&D project to come together and develop a shared mental model in the form of a causal loop model.

6. CONCLUSIONS

Managing R&D projects involves managing multiple stakeholders with conflicting stakes (Elias et al., 2002). This article proposes to use a methodological approach, based on system thinking, to analyse these conflicting stakes so as to arrive at a shared mental model of these conflicting stakeholders. This approach is illustrated using a New Zealand case of 1080 chemical use for pest management. The aim of this paper is not to decide whether New Zealand should or should not use 1080, rather to propose a methodological framework to identify strategies to minimise the level conflict between stakeholders.

In this respect, after the group model building, some of the stakeholders involved in this study, discussed the implications of this model and came up with a few strategic initiatives to change the structure of the system. The first strategic initiative related to increasing research funding (reinforcing loop 5) to find a suitable alternative for 1080. If 1080 is replaced by a suitable alternative, which is able to retain the positive benefits of high bird populations, high native species numbers, and high Tb-free herds through reduced possum/pest numbers, then the conflict between stakeholders over safety and deer hunting sites could reduce. A suitable alternate to 1080 could result in deer hunting sites not affected and no ‘poisoning’ of the land. But as of now there is no suitable alternative, and the conflict between stakeholders continues. There is an opportunity to minimise this stakeholder conflict by increasing the research funding and enabling a wide range of alternatives to be tested and peer-reviewed. Unfortunately at this time the level of research funding has decreased (PCE, 2011).

The second strategic initiative related to improving the decision making processes (balancing loop 2) that are currently employed in this R&D project. The stakeholders felt that the way management engages stakeholders could be improved. There is potential to introduce efficient processes that are more appropriate to deal with the stakeholders involved. Such efficient stakeholder consultation processes could in turn improve the transactional level effectiveness of stakeholder
management in this R&D project. The stakeholders felt that if their concerns were addressed through efficient processes and effective transactions, the level of conflict would reduce.

To summarise, R&D Management literature has acknowledged that R&D projects affect multiple stakeholders with conflicting stakes (Elias et al., 2002, Hall & Martin, 2005; Davenport & Leitch, 2009). However, methodological approaches to deal with such conflicts are limited. This article tries to address this gap by proposing and illustrating a methodological approach, based on systems thinking, for analysing such conflicts holistically. To a practitioner, it offers a participative process that can be used to reveal the mental models of multiple stakeholders involved in an R&D project. Finally, this study could encourage further empirical research, which will help build theory in understanding the complexities involved in managing controversial R&D projects.

REFERENCES


Table 1: Methodological Framework

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Figure 1 Behaviour over time graph

Figure 2 Stakeholder map
Figure 3 Example of a Cluster-‘Stakeholder Perception’

Figure 4 Causal Loop Model