Analysing Stakeholder Dynamics in Environmental Conflict: A New Zealand Transport Infrastructure Project

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Abstract

There is an increasingly common argument in the environmental management literature that much of the environmental and resource management is the management of conflict. One of the challenges, while managing such environmental conflicts, is to understand the dynamics of stakeholders in terms of their changing positions and interests. In this paper we present how a systems thinking and modelling study based on system dynamics, was used to understand the changing positions and interests of stakeholders in an environmental conflict. This study involved five phases, namely, stakeholder analysis, group model building, dynamic modelling, scenario planning and modelling, and implementation and organisational learning. The methodology was applied to a New Zealand case relating to a transportation infrastructure project, called the Transmission Gully project.

Key Words: Dynamics of Stakeholders, System Dynamics, Systems Thinking and Modelling Methodology, Environmental Conflict Management

Introduction

Stakeholder literature is in a state of explosion. Since Freeman (1984) published his landmark book, *Strategic Management: A Stakeholder Approach*, the concept of stakeholders has become embedded in management scholarship and in managers' thinking (Mitchell *et al*., 1997). In the past 15 years stakeholder theory has been applied to issues ranging from organisational restructuring to wildlife management, from R&D management to watershed management and from business ethics to logistics management.

Stakeholder concepts were taken into consideration by some of the system dynamicists in their work (e.g. Gardiner and Ford, 1980). However, there is considerable scope for improvement in systematically incorporating stakeholder concepts into system dynamics. Development of system dynamics models incorporating stakeholder concepts can go a long way in addressing the concern raised in stakeholder literature (e.g. Ramirez, 1999) that the present state of stakeholder analysis is not adequately developed to analyse complex aspects like the dynamics of stakeholders.

Dynamics of stakeholders is acknowledged in the environmental conflict literature, as an area involving complexity and uncertainty (e.g. Mitchell, 2001). For example, dynamics of stakeholders in terms of their changing positions and interests is considered as a problem area in environmental conflict management. In the New Zealand context, the case of the Transmission Gully motorway, presents an interesting case of environmental conflict, where stakeholder dynamics presents a problem for the decision maker and a challenge for the researcher.

This paper presents the results of a PhD study (Elias, 2004) that analysed the dynamics of stakeholders in the Wellington Transmission Gully project. This study used the systems thinking and modelling methodology, based on system dynamics, to analyse stakeholder dynamics. This paper begins with a brief discussion of the theoretical context underpinning this research. It is followed by a discussion of the systems thinking modelling methodology, the case of the Transmission Gully project and how the five phases of the systems thinking and modelling methodology was applied to this case.

Theoretical Framework

The theoretical background of this study is built around three streams of literature: stakeholders, system dynamics and environmental conflict.

Stakeholders

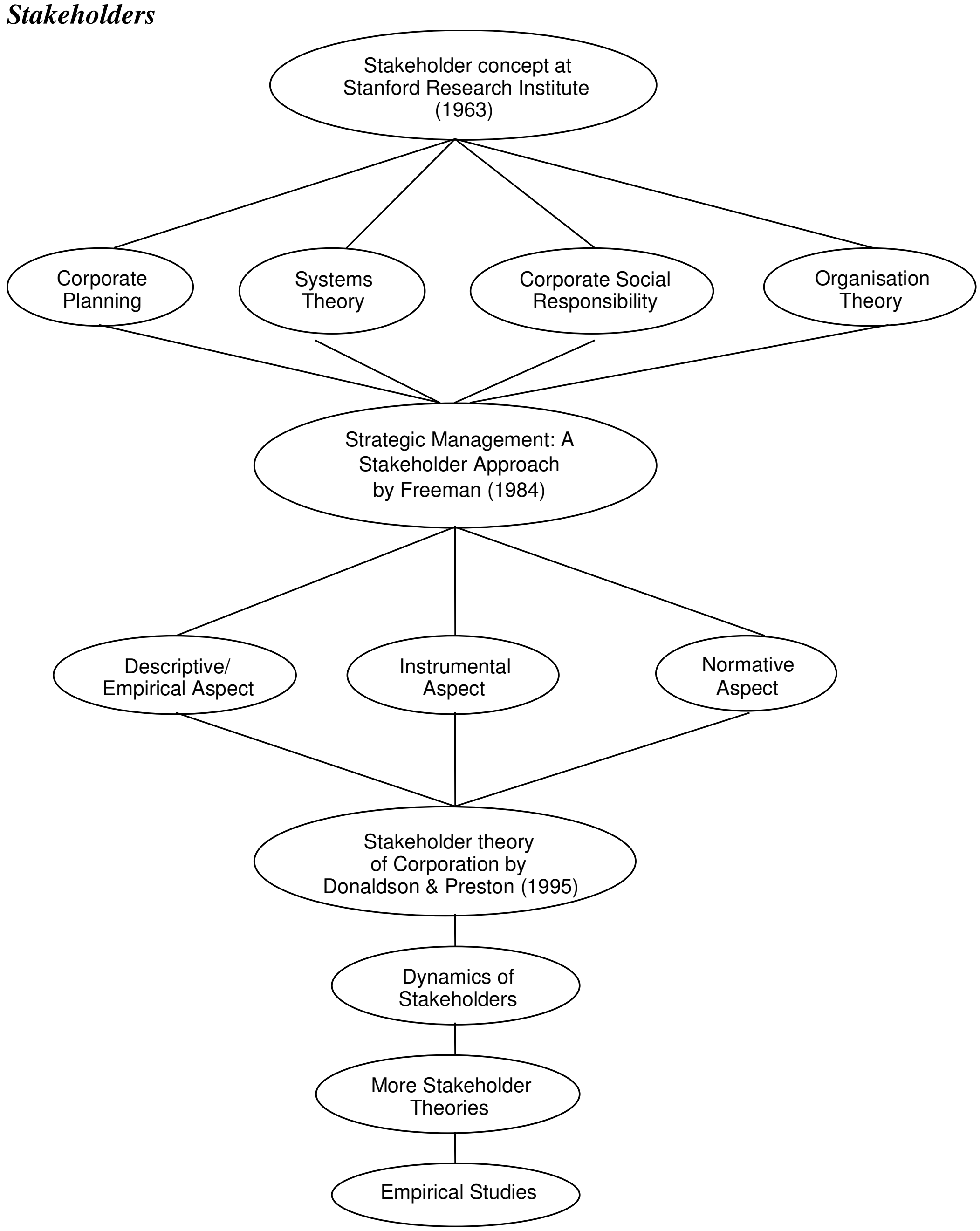


Figure 1. Stakeholder Literature Map

The development of the stakeholder concept in the management literature can be classified into different stages as shown Figure 1. After its origin in 1963, the concept diversified into four different fields namely, corporate planning, systems theory, corporate social responsibility and organisation theory.

The next landmark in the development of stakeholder literature was the book by Freeman (1984), *Strategic Management: A Stakeholder Approach*. After this book, this literature developed around three different aspects namely, descriptive/empirical aspect, instrumental aspect and normative aspect. Donaldson and Preston (1995) brought these three aspects together in their stakeholder theory of corporation.

Further, the stakeholder literature started spreading its wings to interesting areas like dynamics of stakeholder and stakeholder theories. Several empirical studies were also conducted to validate the theoretical claims relating to the stakeholder concepts. A detailed description of this literature map is available in Elias et al. (2000). But, the scope of this paper is restricted to a study on the dynamics of stakeholders.

Dynamics of Stakeholders

Stakeholder literature provides insights into many aspects of stakeholder dynamics. Some examples include:

Changing mix of stakeholders (e.g. Freeman, 1984)

Changing positions and interests of stakeholders (e.g. Beaulieu and Pasquero, 2002)

Changing salience of stakeholders (e.g. Mitchell et al., 1997)

Dynamics of stakeholders is a very interesting and important aspect of the stakeholder concept. Further research and empirical studies are required to gain deeper insights about this aspect.

System Dynamics

In this section, examples from system dynamics literature that used the stakeholder concept are discussed. To make it systematic, it is classified as classical system dynamics, group model building and applications of system dynamics.

Classical System Dynamics

The term classical system dynamics is used here to represent the early works in system dynamics. A survey through the early publications of Forrester (1958-1975) revealed that although he did not use the term stakeholder explicitly, the concept of stakeholders, the differing worldviews of different individuals, and the importance of conflicting opinions were quite extensively used in his work. Some examples include:

Industrial Dynamics: A Major Breakthrough for Decision makers (1958):
Considers stakeholders like managers in the factory, distributors, retailers and customers in the model. Also, prospective purchasers, agencies & media and public

Industrial Dynamics (1961):
A book that presents "*my own personal view*" of the management process.
Explains 'information distortion' - different people and organisations interpret information differently. Prejudices, past history, integrity, hope and internal political environment in organisations all bias information flows.

World Dynamics (1973, p.15):
His guidance for system dynamicists, in a way, covers the essence of stakeholder approach: "The system dynamicist starts most effectively from intense discussions with a group of people who know the system first hand. Such people should be active participants in the social system. They should speak from a variety of backgrounds and viewpoints, so opinions will clash. The atmosphere of the discussion should require that conflicting opinion be at least partially resolved, for it is by that process that the underlying assumptions are most quickly revealed. During such a discussion, the dynamicist gleans the fragments of information from which he assembles a model that captures the essential structure of the system."

Principles of Systems (1968):
He used three categories of stakeholders - managerial-professional, labour and underemployed.

Churches at the Goal Conflict (1975):
Explains that social systems must meet a multiplicity of goals, to fulfil human needs. These goals can conflict with one another in several dimensions - in current trade offs, in time and in hierarchy.

Thus, the concept of stakeholders was used implicitly in classical system dynamics literature. Some of the aspects of this concept that Forrester developed in his work are very useful for stakeholder analysis and specially while trying to incorporate stakeholders into system dynamics models.

Group Model Building
Group model building is another area in the system dynamics literature where the concept of stakeholders appears. The following examples explore stakeholder connections in group model building.

Vennix (1996):
Group model building as a process in which team members exchange the perceptions of a problem.
The goal of group model building is to create a consensus after sufficient deliberation and contrasting of viewpoints.

Forrester (1980); Morecroft and Sterman (1994):
The selection of group members should incorporate a wide variety of viewpoints in order to ensure that the model constructed will not become overly idiosyncratic

Vennix (1996):
It is better to include those who have the power to implement change.
From the point of view of a platform for change, it is better to have one person too many than one too few
Andersen and Richardson (1997):
Initiated a discussion of shared scripts and techniques for group model building

Cavana et al. (1999):
Used it to generate a shared mental model of stakeholders

Rouwette et al. (2002):
Assessed the effectiveness of group model building

Applications of System Dynamics
A review of the system dynamics literature found several applications that used the concept of stakeholders. Forestry, conflict management, public health and environmental management are some interesting examples where these applications can be found. Some examples are given below:

Stenberg (1980):
He used the concept of 'Reference groups' to identify and clarify the problems faced by the Scandinavian forest sector.

Gardiner and Ford (1980):
In one of the first system dynamics papers that explicitly used the term stakeholders, they evaluated 'which policy run is best and who says so'.

They merged system dynamics model with 'Simple Multi-attribute Rating Technique (SMART)', a version of multi-attribute utility measurement.

Gill (1998):
He used an approach labelled IDeaMaP, combining cognitive-mapping and system dynamics and applied it to local and regional environmental planning problems in Australia. Its features include a major focus on the facilitation of comprehensive stakeholder involvement, ownership and learning.

Hsiao (1998):
He proposed a conflict analysis procedure combining judgement analysis with system dynamics and used the Job Opportunities and Basic Skills Training (JOBS) welfare reform programme as a case study with three hypothetical policy stakeholders.

Cavana et al. (1999):
They described an attempt at surfacing the conflicting worldviews of stakeholders like clinicians and health care managers at the New Zealand Ministry of Health.

Stave (2002):
Her research supported a stakeholder advisory group in environmental decisions.

Thus, this review suggests that the possibility of using system dynamics methodology for analysing stakeholder.

Environmental Conflict
Environmental and resource management literature provides some interesting definitions for environmental conflict. For example, US government's environmental policy and conflict resolution statute of 1998 defines the term environmental conflict (dispute) as a dispute or conflict relating to the environment, public lands, or natural resources (Environmental Manager, 1988). A review of the environmental conflict literature found some interesting aspects and applications of stakeholder dynamics. Some examples are given below:

Changing positions and interests of stakeholders (e.g. Beckenstein *et al*., 1996)

Changing structure, attitudes and behaviour of stakeholders (Mitchell, 2001)

Changing salience of stakeholders (Ramirez, 1999)

Interplay between nature of the problem, its boundaries and owners (Ramirez, 1999)

To summarise, as shown in Figure 2, the theoretical framework links three different streams of literature, namely, stakeholders, system dynamics, and environmental conflict.

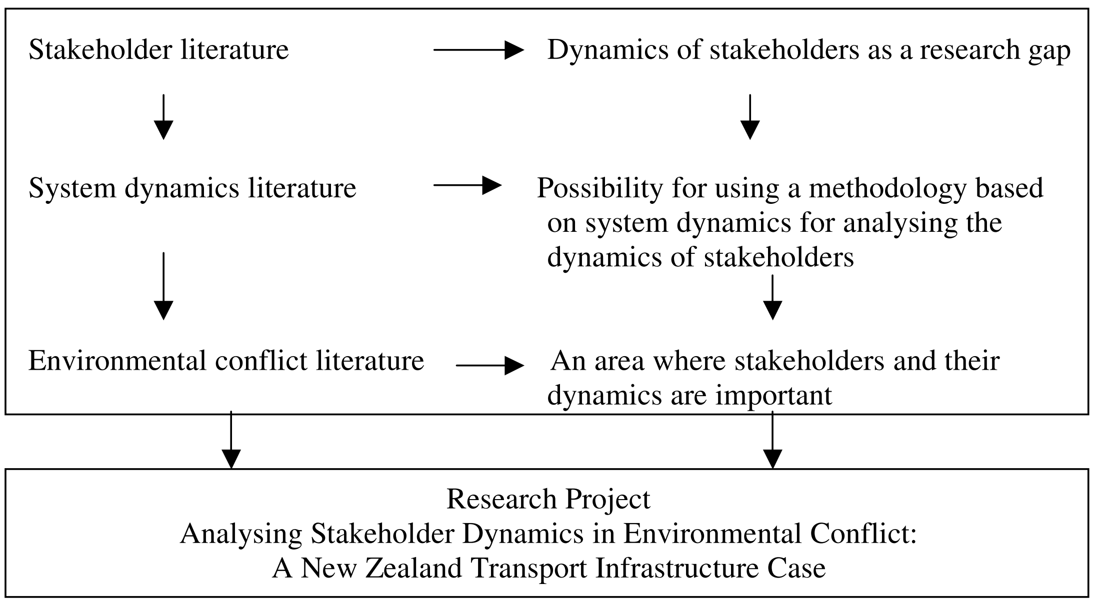


Figure 2. Summary of Theoretical Framework

Methodological Framework

This study used the Systems Thinking and Modelling methodology. Systems Thinking and Modelling is a methodological framework based on the system dynamics approach. Maani and Cavana (2000) developed this framework and presented it in their book, '*Systems Thinking and Modelling: Understanding Change and Complexity*'. According to Maani and Cavana (2000) the development of systems thinking and modelling intervention involves five major phases as shown in Figure 3.

	Phases
1.	Problem Structuring
2.	Causal Loop Modelling
3.	Dynamic Modelling
4.	Scenario Planning and Modelling
5.	Implementation and Organisational Learning

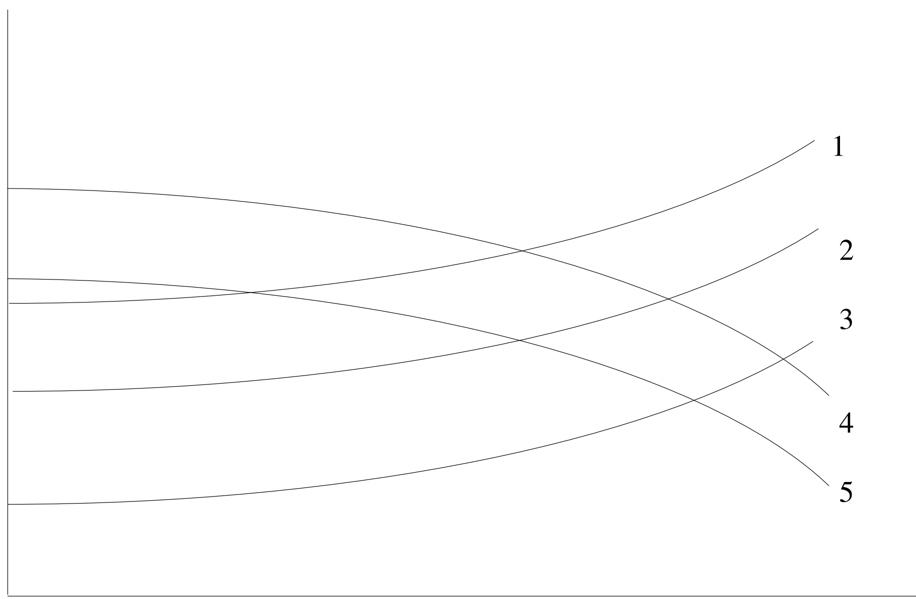
Source: Maani and Cavana, 2000, Table 2.1, p.16.

Figure 3. Phases of the Systems Thinking and Modelling Methodology

A review of the system dynamics literature revealed that the Systems Thinking and Modelling Methodology was successfully used in different applications involving stakeholders (e.g. Elias et al., 2002, Cavana et al., 1999). This study found some interesting characteristics of this methodology that makes it suitable for applications involving stakeholders. For example, it incorporates both the hard and soft approaches to systems thinking and also strikes a delicate balance between these two approaches to systems thinking. Such characteristics make it possible to use this methodological framework to analyse different dimensions of the stakeholder concepts, including the dynamics of stakeholders.

The Case of Transmission Gully

The Wellington Regional Council had been seeking a suitable solution to the increasing problems of congestion, safety and community severance along the existing State highway route between Paremata and Paekakariki. Analysing Wellington Regional Council's data since 1990, for 7.00 to 9.00 a.m. travel between Paremata and Paekakariki, it was seen that the traffic volume, travel time and CO_2 emissions were increasing steadily. But, speed of travel and attractiveness to driving was decreasing (Figure 4).



1=Traffic volume, 2= Travel time, 3=CO_2 emissions, 4= Speed, 5 = Attractiveness of driving

Figure 4. Reference Mode

A possible solution to these problems was the construction of the Transmission Gully motorway, a 27-km inland route. The vision of the Wellington Regional Transport strategy, as explained in the Wellington Regional Land Transport Strategy, 1999 –2004 (Wellington Regional Council, 1999) was 'A balanced and suitable land transport system that meets the needs of the regional community', and it in turn demands, the proposed Transmission Gully motorway to be environmentally and economically sustainable.

The case of the Transmission Gully project presented an interesting example of environmental conflict. This study found that the idea of the Transmission Gully project was conceived as early as 1915. Later in 1940, the US army, camped at Queen

Elizabeth Park during World War II, found the present highway insecure and proposed an alternate route through the Transmission Gully. The American government offered to fully fund the project, but due to political reasons, the New Zealand government rejected the offer. Our identification of the milestones of this project during the last 90 years, revealed the importance of such stakeholder behaviour that resulted in the delay of this project.

After 89 years since its birth, the Transmission Gully project still made occasional headlines in the New Zealand media. The conflict between different stakeholders that kept on surfacing, presented increasing challenges to the transport planning managers of the Wellington Regional Council.

Stakeholder Analysis

In the first phase of this research, namely problem structuring, a stakeholder analysis was conducted for the Transmission Gully motorway. For this purpose, a stakeholder analysis methodology, based on the literature (e.g. Freeman, 1984; Mitchell *et al.*, 1997) was applied. This methodology consisted of the following steps:

Developing a stakeholder map of the project

Preparing a chart of specific stakeholders

Identifying the stakes of stakeholders

Preparing a power versus stake grid

Conducting a process level stakeholder analysis

Conducting a transactional level stakeholder analysis

Determining the stakeholder management capability of the project

Analysing the salience of stakeholders and

Analysing the changing positions and interests of stakeholders

The stakeholder map developed as a starting point to this stakeholder analysis is shown in Figure 5.

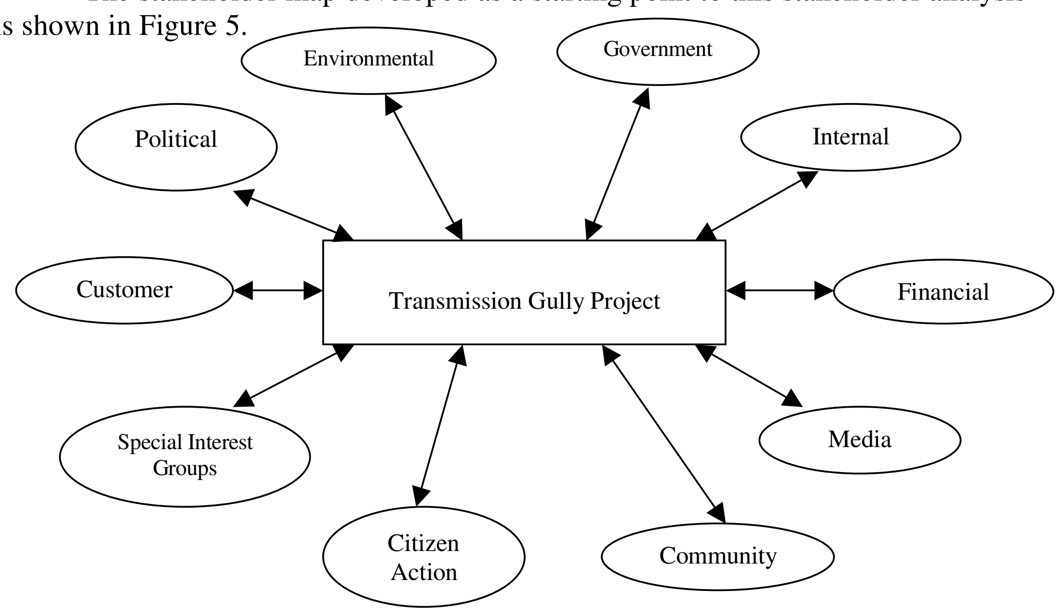


Figure 5. Stakeholder Map of the Transmission Gully Project

Group Model Building

In the second phase of this study, group model building exercises were conducted to generate a casual loop model. Key stakeholders belonging to the different categories, as identified in the stakeholder map, participated in it. Among the different methods available for group model building, this study used hexagons for systems thinking, outlined in Cavana et al. (1999) and Maani and Cavana (2000) with the steps:

Hexagon generation

Cluster formation

Variable identification and

Causal-loop development

Maani and Cavana (2000) have explained this procedure systematically in their Systems Thinking and Modelling methodology, based on Hodgson's (1994) use of hexagons for issue conceptualisation and Kreutzer's FASTbreakTM process (1995) for using hexagons to develop causal loop diagrams.

In the group model building sessions, the stakeholders generated hexagons (Hodgson, 1994, Cavana et al., 1999), based on their opinions regarding Transmission Gully. Similar hexagons were later formed into a cluster and few variables were identified to represent these clusters. Those variables that were related were then connected using directed arrows to generate an initial causal loop diagram. The diagram was later modified (Figure 6), based on system dynamics literature (e.g. Sterman, 2000) to capture the feedback loops operating in the system. On analysing the causal loop diagram, seven balancing (B_1 – B_7) and two reinforcing feedback loops (R_1, R_2) were identified.

A behaviour over time chart (Figure 7), based on the causal loop diagram shows that travel time will keep on increasing till Transmission Gully is constructed and ready to use. Travel time will come down once vehicles start using this additional road. But later, travel time will start increasing due to an increasing number of cars on the road. Traffic volume will keep on increasing before and after the construction of Transmission Gully. The amount of CO_2 emissions will behave in a similar way as the traffic volume. Speed will keep on decreasing till Transmission Gully is ready to use.

Then it will increase for some time, but at some later point in time, it will start decreasing. The attractiveness of driving will also behave in a similar fashion like the speed, first it will decrease, then it will increase and after some time, it will start decreasing, due to an increasing travel time.

In summary, group model building was found useful in this study, for revealing the various interests of stakeholders in this environmental conflict situation. It also helped the stakeholders to generate a shared mental model, in the form of a causal loop diagram.

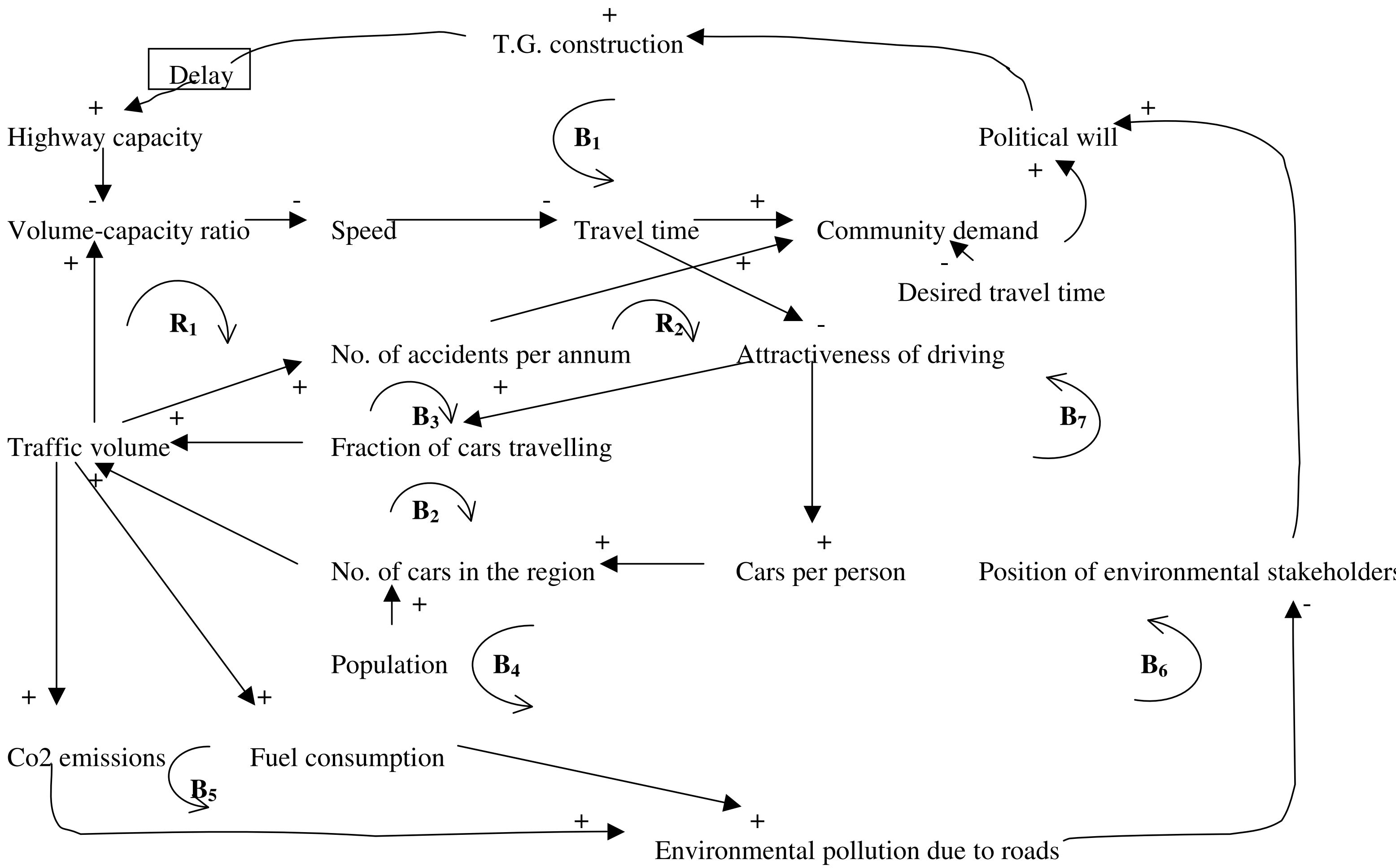
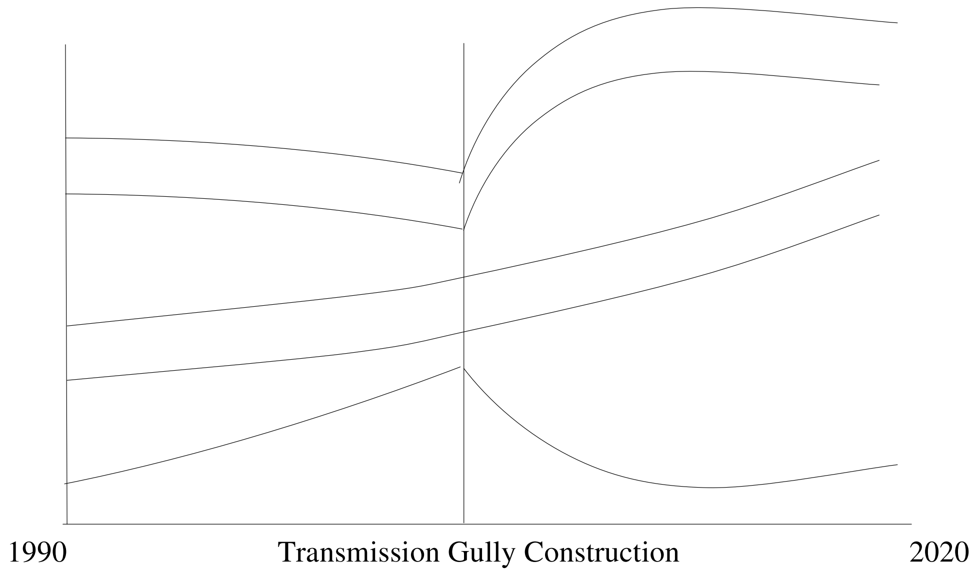


Figure 6. Modified Causal Loop Model



1=Traffic volume, 2= Travel time, 3=CO_2 emissions, 4= Speed, 5 = Attractiveness of driving

Figure 7. Behaviour Over Time Chart with Transmission Gully Constructed

Dynamic Modelling

In this third phase, a dynamic model was developed using the *ithink* software(Richmond and Peterson, 1997). This model was based on the modified casual loop model, but it was restricted to the interests of community and environmental stakeholders only.

The development of this system dynamics model included the following steps:

Review of transport modelling literature:
During this step, both general transport modelling (e.g. Homburger *et al.*, 1982) and system dynamics literature related to transport modelling (e.g. ASTRA, 1998) were reviewed.

Developing a high-level systems map:
The high-level map developed in this research is presented in Figure 8. It includes four major sectors, namely, traffic, interests of community stakeholders, interests of environmental stakeholders, and stakeholder positions.

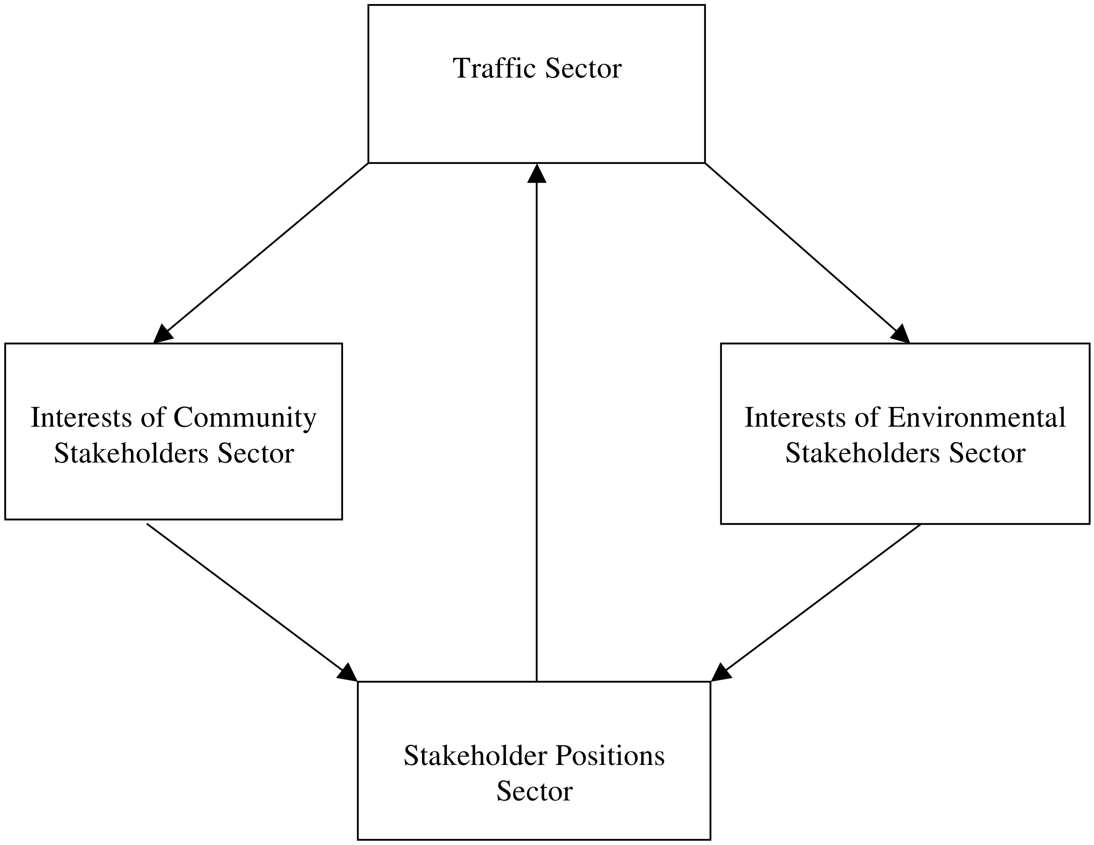


Figure 8. High-level Systems Map

Defining variable types and constructing a stock-flow diagram:
Figure 9 presents the stock flow diagram developed in this study. It shows how variables like travel time and traffic volume affect variables like carbon dioxide emissions and accidents per annum in the stakeholder interests sector. These variables are connected to the changing positions of stakeholders in the stakeholder positions sector, influencing whether the Transmission Gully project should go ahead, which further affects the traffic sector, and thus completing the overall main feedback loop.

Developing a simulation model
In this step, all the variables in the stock flow diagram were provided with an equation. Then, the dimensional consistencies of these equations were checked so that it was possible to convert the dimensions of the variables on the right-hand side of the equation to those on the left-hand side. Also, each equation in the model was documented. Details of this model are provided in Elias (2004).

Reproducing reference mode behaviour
This step involved putting in provisional values for the parameters at first, to try and reproduce the general pattern of the reference mode (behaviour over time of the main variables). When the reference mode is reproduced, it is generally called the base case version (Figure 10) of the model (Maani and Cavana, 2000).

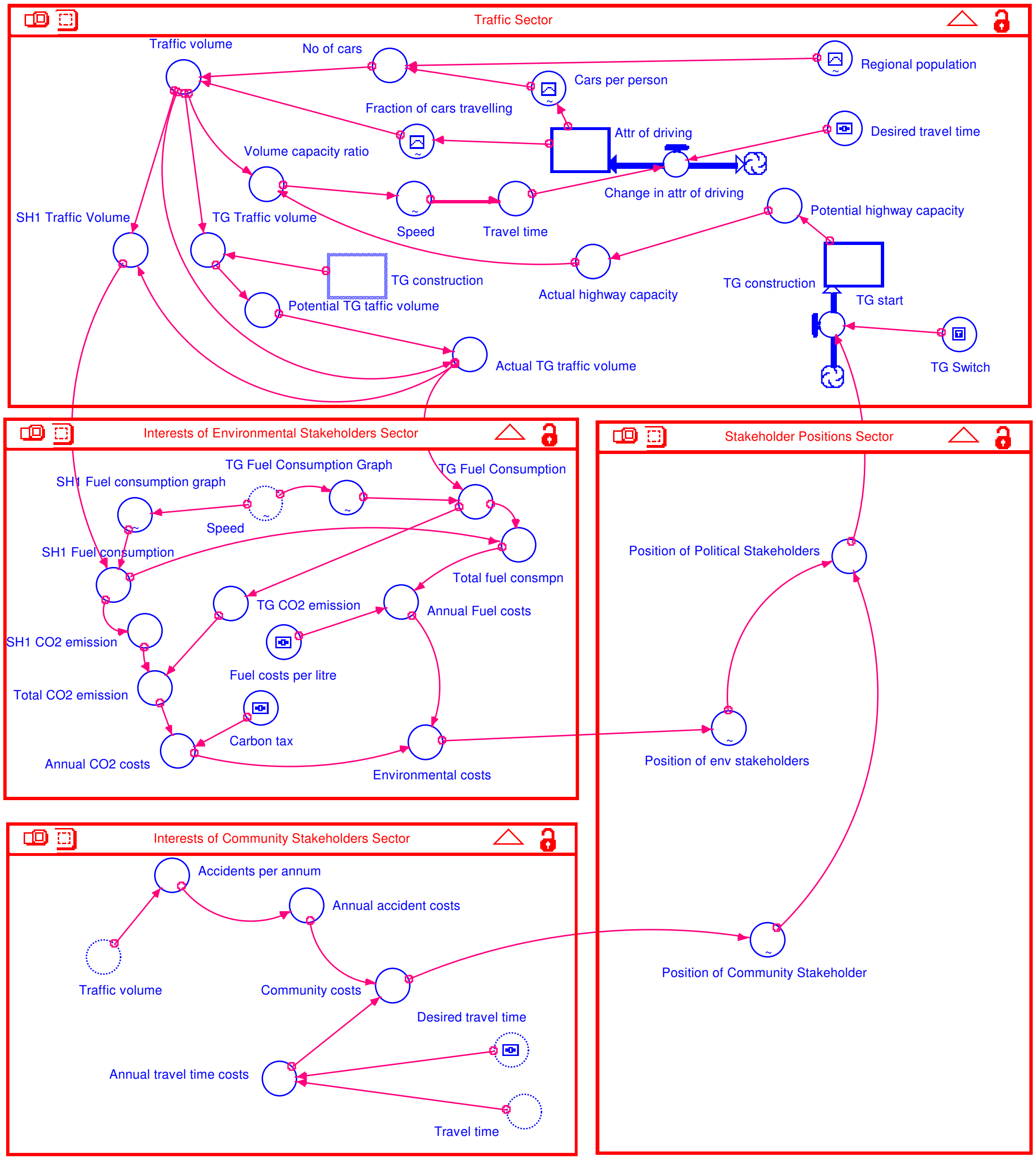


Figure 9. Stock Flow Diagram

Validating the model

According to Forrester and Senge (1980), it is very important to build confidence among the users of a model regarding its soundness and usefulness. Keeping this in mind, the base case version of the model was subjected to a range of validation tests suggested by Coyle (1996) and Maani and Cavana (2000).

Performing sensitivity tests:

The system dynamics model developed in this research was subjected to sensitivity analysis. The goal of sensitivity analysis was to learn if the basic pattern of results is sensitive to changes in the uncertain parameters (Ford, 1999). Based on Maani and Cavana (2000), the sensitivity analysis involved varying most of the model parameters and graphical relationships by plus or minus 10%. The results of

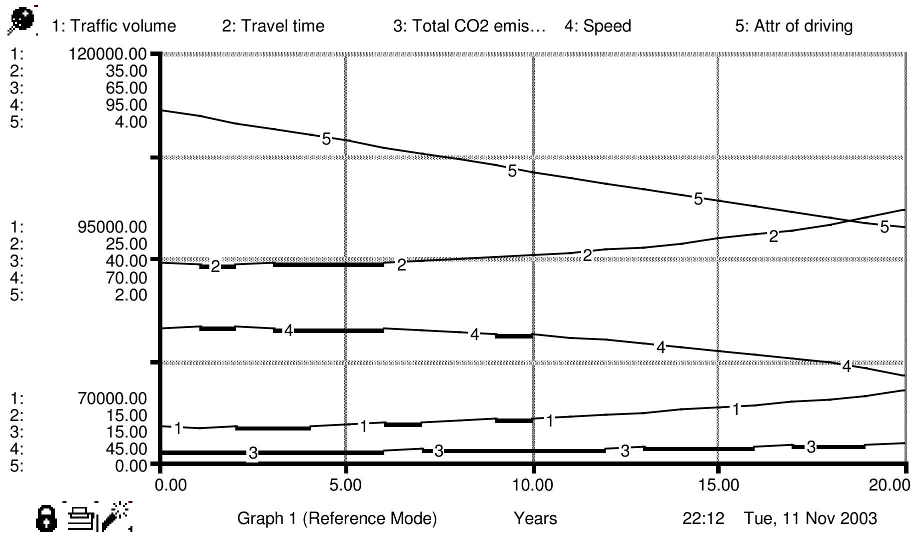


Figure 10. Graphical Output of the Base Case

this sensitivity analysis identified the most sensitive parameters/graphical relationships in the model.

Scenario Planning and Modelling

In the fourth phase, policy and scenario experiments were conducted on the model using a management flight simulator (Figure 11).

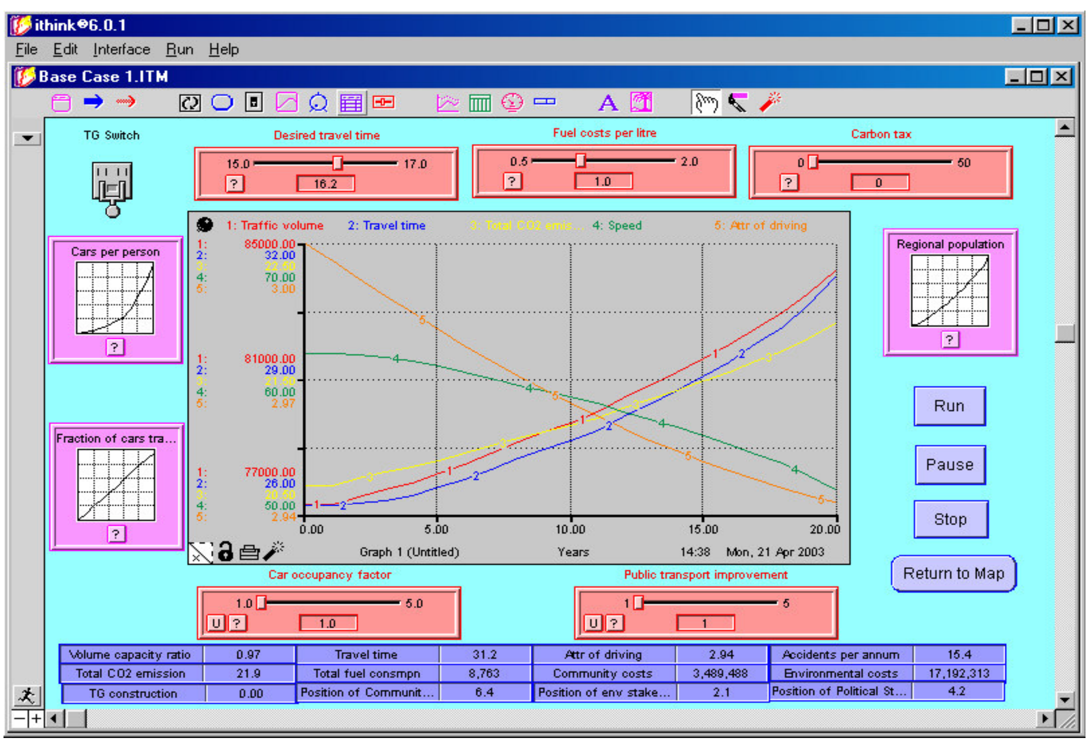


Figure 11. The Transmission Gully Management Flight Simulator

Effects of the Transmission Gully Motorway
The first policy experiment tested the effects of Transmission Gully construction. The graphical results of this experiment are presented in Figure 12.

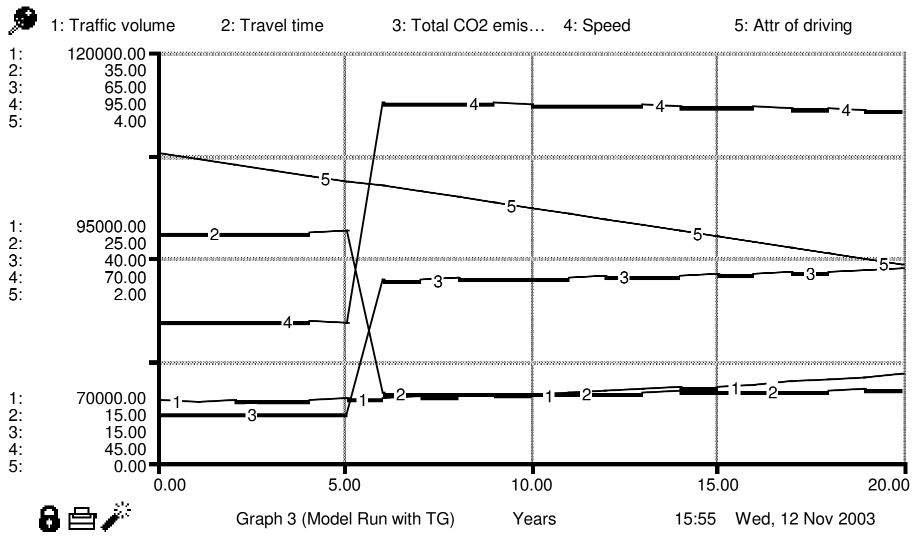


Figure 12. Model Run With Transmission Gully Option

These results highlighted some interesting patterns of behaviour, once the Transmission Gully motorway was available for the motorists (year 5, in this case). For example, it showed that some of the congestion related variables (e.g. traffic volume) increase, even with the introduction of this new motorway. Some other variables decreased or increased significantly in the short term (e.g. travel time, speed), but in the long term they behaved in the opposite direction.

Effects of Car Pooling
The second policy experiment consisted of testing the effects of car-pooling, since the Wellington Regional Council was trying to promote car-pooling. In this experiment, car occupancy was increased from 1 to 5. Results of these experiments for model runs with and without the Transmission Gully motorway were analysed in this study. Table 1 presents the results of these experiments without the Transmission Gully motorway.

Car Occupancy	**1**	**2**	**3**	**4**	**5**
Volume capacity ratio	0.94	0.47	0.32	0.25	0.20
Travel time (min)	28.4	18.5	16.9	16.2	15.7
Attractiveness of driving	1.99	1.92	2.63	3.13	3.49
Accidents per annum	14.7	7.4	5.1	3.9	3.1
Total CO2 emission (tones)	21.3	12.9	9.4	7.5	6.2
Total fuel consumption (litres)	8,539	5,164	3,747	2,983	2,482
Community costs (NZ$m)	3.34	1.67	1.15	8.89	7.23
Environmental costs (NZ$m)	1.67	1.01	7.35	5.85	4.87
TG construction	No	No	No	No	No
Position of com. stakeholders	6.3	5.3	4.8	4.5	4.3
Position of env. stakeholders	2.2	3.1	3.5	3.8	4.0
Position of pol. stakeholders	4.2	4.2	4.2	4.1	4.1

Table 1. Effects of Car Pooling – without Transmission Gully

(Note: Position of stakeholders were modelled as a 7-point itemised rating scale, where 1= extremely opposed; 2=very opposed; 3=opposed; 4=neutral; 5=supportive; 6=very supportive; 7=extremely supportive).

The results of the simulation runs without the Transmission Gully motorway showed a reduction in traffic variables like volume capacity ratio and travel time. It also showed a decrease in stakeholder interests like carbon dioxide emissions, fuel consumption and accidents per annum. From a 'very supportive' position, the position of community stakeholders was becoming more neutral, since the impacts of congestion on community were reducing. The environmental stakeholders also moved towards a neutral position from a very opposed position.

Attractiveness of Driving

Although this experiment showed some positive effects on reducing congestion, it also highlighted an interesting counter-intuitive behaviour emerging for the attractiveness of driving variable. When the car occupancy factor was increased to a particular level (e.g. 3 in the model run without the Transmission Gully motorway), so that congestion decreased significantly, the attractiveness of driving started to increase. This behaviour, in turn, could increase congestion. This situation could be explained by summing up the comments of a group of powerful people in a Canadian city: "Let us improve car-pooling and public transport of this city, so that people will be attracted to these alternative transport means, and stop using their cars; so that we can drive our cars comfortably" (L. Jackson, Pers. Comm. 2003).

Thus, these results showed that generally, car-pooling was quite effective in decreasing traffic congestion, decreasing environmental and community stress due to traffic and in decreasing the conflict between stakeholders. Other system dynamic researchers have also reported the usefulness of car-pooling (e.g. Stave, 2002). While supporting a stakeholder advisory group examining transportation and related air quality problems, she found that car-pooling reduces congestion, costs very little, and significantly improves air quality. So, in general these results supported the efforts of Wellington Regional Council in promoting car-pooling.

This policy experiment also raises the issue of increasing attractiveness of driving when car-pooling is over done. For the policy makers of the Wellington Regional Council, this presents a challenge for maintaining a delicate balance between popularising car-pooling and controlling congestion.

Effects of Public Transport Improvements

As the third set of policy experiments, the effects of public transport improvements in the Wellington region were studied. Experiments were conducted by increasing the public transport improvements from 1 to 5. To elaborate, a value of 2 for public transport improvement meant the Wellington Regional Council increasing its public transport improvement efforts, including funding, by two times; 3 means three times and so on.

The results of these experiments were similar to the results of the previous policy experiment on car-pooling. They yield positive results, in terms of reducing congestion, decreasing accidents, decreasing environmental stress and in moving the positions of community and environmental stakeholders to a more neutral stand. However, as in the earlier policy experiment, the counter-intuitive behaviour of increasing attractiveness of driving with increasing public transport improvements was also visible clearly.

Scenario Analysis
The second type of experiments conducted in this phase involved a scenario analysis. This was conducted using the following steps given in Maani and Cavana (2000, pp.85, 246-250), based on Schoemaker (1993).

Planning general scope of scenarios

Identifying key drivers of change and keynote uncertainties

Constructing forced scenarios

Checking for internal consistency, plausibility and credibility

Constructing learning scenarios

Simulating scenarios with the model
The learning scenarios were:

Do Nothing (Status quo/base case)

*Cleaner Greener Aotearoa (*A more environmental friendly New Zealand*) and*

Kapiti – Exploding with People and Cars
(A picture of increasing attractiveness of Kapiti as a place)

Variables	Do Nothing	Cleaner Greener Aotearoa	Kapiti - Exploding with People and Cars
Volume capacity ratio	0.47	0.10	0.74
Travel time (min)	18.5	15.0	22.9
Attractiveness of driving	1.92	4.07	1.90
Accidents per annum	14.7	3.3	23.3
Total CO2 emission (tones)	38.3	9.6	55.3
Total Fuel consmpn.(litres)	15,332	3,853	22,105
Community costs (NZ$m)	3.34	7.49	5.29
Environmental costs (NZ$m)	30.1	9.14	4.34
TG Construction	Yes	Yes	Yes
Position of Comm. Stkldrs.	6.3	4.3	6.9
Position of Env. Stkhldrs.	1.5	3.2	1.1
Position of Pol. Stkhldrs.	3.9	3.8	4.0

Table 2. Scenario Analysis – with Transmission Gully

The results (Table 2) showed that 'Cleaner Greener Aotearoa' scenario paints a glossy picture of many aspects related to this environmental conflict. However, attractiveness of driving was an exception and its increase was a concern. Nevertheless, if attractiveness of driving could be controlled within reasonable limits, this scenario could go a long way in resolving some of the issues related to the conflicts between the stakeholders of the Transmission Gully project.

The ‘Kapiti - Exploding with People and Cars’ scenario painted a grim picture of the environmental conflict relating to the Transmission Gully project. This scenario showed some chaotic behaviour in terms of congestion, interests of environmental and community stakeholders, and their positions in this environmental conflict.

Implementation and Organisational Learning

In the last phase of this study, the model was taken to five key stakeholders who were involved in the earlier phases of this study and experiments were conducted in their presence. These five stakeholders included a transport planner, a policy manager, an environmental stakeholder, a political stakeholder and a community stakeholder**.**

In these sessions, following issues were discussed:

Usefulness of the model

Soundness of the model

Its ability to capture complexities

Effect of such an exercise on positions and interests of stakeholders and

How that stakeholder would use the model

Four out of the five stakeholders found this exercise generally useful. The community stakeholder was an exception and he felt that this exercise muddies the waters, since it re-emphasises the complexity of the issues. Regarding the soundness of the model, the stakeholders were generally comfortable, although each of them suggested some problems or improvements in the model. Regarding the ability of this exercise in capturing the complexity of the system, all the five stakeholders agreed that the model was able to capture the complexities of the system.

On the question of whether an exercise like this study could change the positions and interests of stakeholders who were involved in this exercise, the five stakeholders, in general, felt that such a change is possible. For example, the transport planner felt that environmental stakeholders might change their positions, but not immediately. The environmental stakeholder felt that the results of this exercise would strengthen the present position of environmental stakeholders. The policy manager opined that political stakeholders tend to have simplistic views and this exercise could help in expanding their understanding and thus changing their positions. The political stakeholder observed that the politicians would change and so does their positions. The community stakeholder’s opinion was different and he said that political stakeholders might become more confused and would hide behind these findings.

All the five stakeholders agreed that learning would affect positions; and most of them said that this change might not happen immediately. They also said that they would use the model for different purposes (e.g. as a discussion tool, making submissions, arguing with politicians etc.).

To summarise this phase, the experiments with the stakeholders resulted in some valuable feedback about the model. This process also helped in improving the validity of the model.

Conclusions

In our opinion, this research contributes to the fields of system dynamics, stakeholder and environmental conflict management. The stakeholder analysis provides an alternative approach to problem structuring in system dynamics by systematically identifying the stakeholders, their stakes and dynamics. The group model building process gives an opportunity for the participating stakeholders to present their views about a controversial project and help them develop a shared mental model of the environmental conflict situation. The process of developing a dynamic model helps in the better understanding of the complexities and connections between the different concerns of different stakeholders involved in an environmental conflict. Testing different policies and scenarios in this model, helped the stakeholders in learning more about the holistic dimensions of the conflict, future implications of the conflict and ways of improving the possibilities for resolving the conflict.

In conclusion, this research contributes a new application of the systems thinking and modelling methodology based on system dynamics, to the field of environmental conflict management involving the analysis of stakeholders and their dynamics.

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