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**THE MATRIX, THE SPIDERWEB AND THE
INFLUENCE DIAGRAM: DEVELOPMENTS IN
SYSTEMS THINKING AT THE NEW ZEALAND
CUSTOMS SERVICE**

Robert Y. Cavana and Leslie V. Clifford

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The Matrix, the Spiderweb & the Influence Diagram: Developments in Systems Thinking at the New Zealand Customs Service

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Abstract

This paper discusses the introduction of systems thinking concepts into the strategic planning process at New Zealand Customs Service (NZCS). The recent state sector reforms and restructuring at NZCS are briefly outlined. A Working Group of government officials from NZCS, Treasury and State Services Commission was engaged to undertake a Baseline Review of Customs activities. This included commissioning a pilot study to investigate the suitability of the system dynamics methodology to determine the desired purchase mix for the NZCS. The pilot study was performed on the "Search for Drugs" output group from the Purchase Agreement between the Minister of Customs and the Chief Executive of NZCS. This paper summarises the pilot study and presents a range of system diagrams showing the interrelationships between the inputs, outputs and outcomes associated with the search activity. A lack of suitable data and appropriate outcome measurements precluded the development of a quantitative model. However, the study has provided a framework for strategic analysis at the NZCS.

Keywords: New Zealand Customs Service, drugs search, state sector reforms, systems thinking, system dynamics, strategic analysis.

Introduction

New Zealand's State Sector and Financial Reforms

The reforms to the State sector and the New Zealand economy began in mid-1984. One of the underlying principles of these reforms was that all sectors of the economy should be exposed to the forces of competition. The key overall concepts in the Government's approach were transparency and consistency, and it was the former which brought the most radical changes to the structures and systems of the state. Comprehensive reviews of these reforms have been provided by Boston *et al.* (1991 & 1996), Boston and Pallot (1997), Evans *et al.* (1996), Scott *et al.* (1997) and SSC (1998a & b). The three main elements of the New Zealand reform process were:

- privatisation and corporatisation (the creation of "State Owned Enterprises");
- various sectoral reforms (e.g. in the education sector); and
- financial management reform, which restructured the way core government departments and Crown entities operated.

The ultimate aim of the financial management reforms was to achieve better value from public spending. This required attention to management of government agencies and to the choices of goods and services and the transfers paid for by taxpayers. It also required attention to the quality of policy advice since regulatory interventions and legal changes needed to be considered as alternatives to spending options.

Key Concepts underpinning the Reforms

Several concepts underpinned the reform in New Zealand including distinctions between: "outcomes" and "outputs" & "purchaser" and "owner". The reforms also involved the adoption of a contracting approach to various relationships. (Refer to Scott *et al.* (1997) and SSC (1998a & b) for a full discussion of these concepts).

Outcomes and Outputs: Outcomes are the impacts on, or consequences for, the community of the department's activities. Desired outcomes provide the rationale for Government action. Outcomes are influenced, but not controlled, by individual departments. New Zealand Customs, along with a number of other departments or agencies, may contribute to a particular outcome.

Outputs are the goods and services produced by departments. New Zealand Customs has control over its outputs and is therefore accountable for their production and delivery. This aspect distinguishes 'outputs' from 'outcomes' as described above.

The Government decides what it wants to achieve. It selects the outputs or other interventions which will have the desired effect. It then allocates resources to those outputs, by "purchasing" the selected services from departments.

Purchaser and Owner: The Crown has both a 'purchase' and an 'ownership' interest in departments and Crown entities. As purchaser, it is interested in the goods and services (outputs) it is purchasing - their quantity, quality, cost and timeliness.

As owner the Crown is interested in the entity's ability to deliver contracted outputs at least cost, both now and in the future. This means the Crown is interested in efficient resource management, including financial management (working capital and asset utilisation), and any changes necessary to deliver future outputs.

The Contracting Model: The contracting model is at the heart of the reforms. Appropriation is for price (payment for delivery of outputs), not cost (cash for inputs). The contract with providers is called a "Purchase Agreement" (Treasury, 1995), which contains terms and conditions similar to (although less detailed than) any private sector contract. The purchase agreement, specifying which outputs are being purchased from the department, is signed by the CEO and the responsible Minister after the Budget (Parliamentary appropriation at the output class level) is agreed.

Control Agencies / Central Agencies : Before the changes brought about by the State Sector Act in particular, the Treasury and the State Services Commission were known as "control agencies". After the introduction of the reforms they are referred to as "central agencies". The change is significant; their function is no longer to control inputs to departmental activities, but rather, along with the Department of the Prime Minister and Cabinet, to co-ordinate policy and monitor performance in purchase and ownership areas.

New Zealand Customs Service - public sector organisation undergoing dramatic change

It was at a stage when the NZCS had adopted accrual accounting and had a couple of years experience in producing a Purchase Agreement, that it developed its first Strategic Plan (in 1994). This exercise tapped a reservoir of unease in Customs, that state sector reforms had led to a situation where Customs had not enough money, too few people and too idiosyncratic an approach to management of its business for the department to prosper. The exercise unleashed a wellspring of ideas and basic strategies. Many of these came to life through the CusMod project, a NZ\$22 million modernisation of the information technology platform and associated applications software.

Coincidental with the development of the first strategic plan was an increase in the attention given by the government's central agencies to the government's desire that state sector expenditure be reduced, and to making accountability for accomplishing ownership as well as purchaser interests clear (ie "transparent") (discussed fully in SSC 1998a).

As it happened, this created a sense of 'tension' between the ownership interest in having an organisation with an ongoing capability to carry out its role in the manner expected of the Public Service - which would require investment in corporate systems not funded by the modernisation programme¹ - and the purchaser interest in accomplishing reductions in operating expenditure for reasons of fiscal policy.

¹ See the section below on Customs Baseline Review for details of what the programme encompassed.

The stage was set for a tripartite review of the Customs baseline, which inter alia was the catalyst for a pilot of the system dynamics modelling methodology. Figure 1 summarises these developments and the general structure of this paper.

The next section briefly discusses the Customs baseline review, and the ‘matrix’ and ‘spiderweb’ approaches to mapping the linkages between outputs and outcomes. This is followed by an overview of the system dynamics study and related system diagrams developed for the study. Some of the problems and issues associated with collecting Customs data for strategic analysis are outlined next. Finally, some conclusions are provided based on the pilot study, and the subsequent thinking shifts at Customs towards strategic planning, strategic alignments and systems thinking.

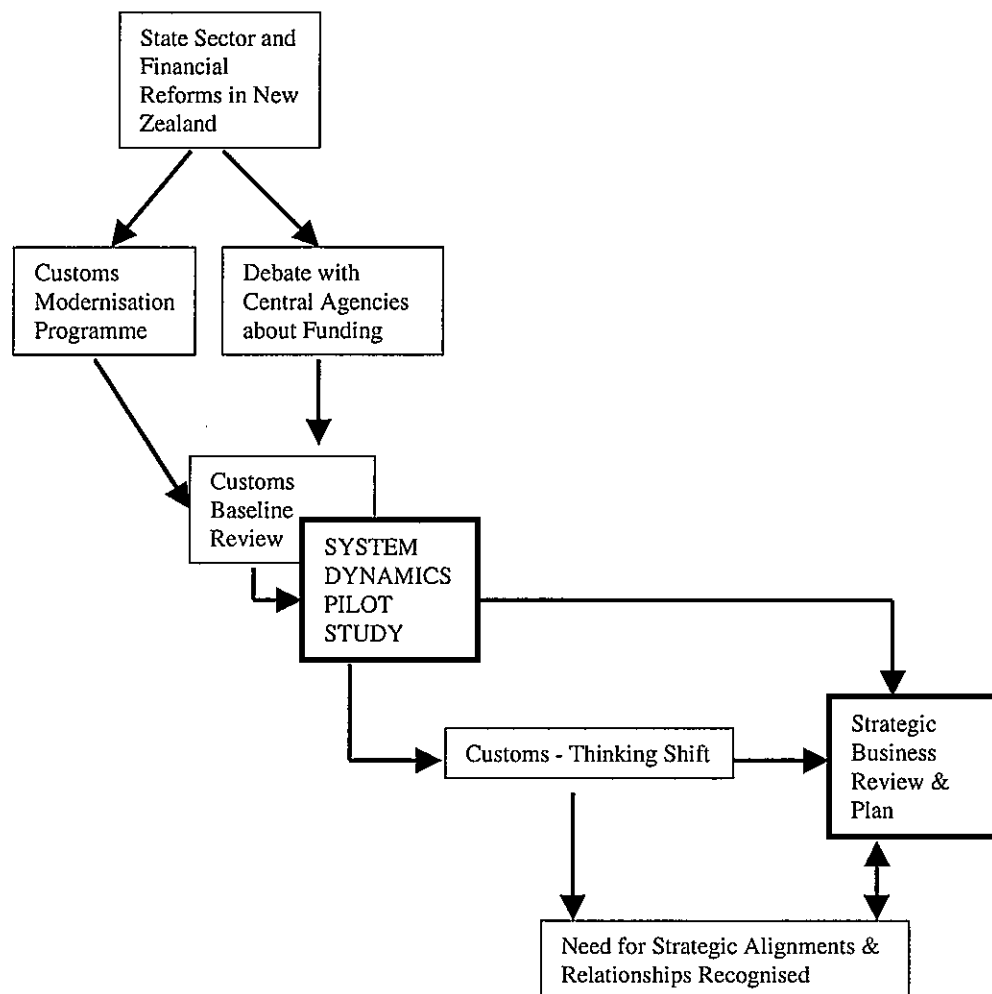


Figure 1: Developments in Systems Thinking at NZ Customs Service

Customs Baseline Review

It was against the backdrop of the State sector reforms that the New Zealand Customs Service embarked upon an ambitious modernisation programme in 1995, which led to the adoption of new legislation and a new computer infrastructure. The third leg of the treble was to be the incremental adoption of a revised organisation culture as these two bedded down.

However, the Treasury Department - which advises Ministers on a variety of fiscal and macro economic matters, was not happy that the financial benefits of the computer modernisation programme were big enough. It pressed for a significant reduction in operational funding, and the NZCS resisted. The end result was a decision by Cabinet to have a Working Group² look into the matter, using a terms of reference which encapsulated the key areas of difficulty for Treasury and the NZCS, and which involved also the State Services Commission (SSC) - the department of state responsible for monitoring the Government's ownership interest across the State sector.

The Working Group was to determine what level and mix of outputs was appropriate for the New Zealand Customs Service to produce to meet the Government's objectives (being known as outcomes), to identify the cost of these outputs and to consider what price the Government should pay for them utilising a benchmark price for a given quantity and quality of service. In addition, the Working Group was also to consider which services should be contestible.

A very aggressive timetable was set which turned out to be unrealistic. This was not surprising given the scope of the work and the fact that Customs, like many other departments, did not have a modern cost accounting system or robust costing methodologies, or a repository of accessible information about the effects of its activities upon the risks of accomplishment of outcomes. There were not only timing difficulties. Customs wanted involvement of policy ministries, from whose interests a large portion of its work derives.

Customs needed a new tool to help communicate that matters were not simple and that there was a multiple inter-connectedness between itself and many other departments, which could not be ignored by the review process without endangering wider Government objectives. The first effort at this meaningful communication came in the form of a matrix (see an example in Table 1). This showed that many outputs contributed to each outcome. A sense of this can be gained from the output class description for Search and Surveillance, as follows "Under this output class, the New Zealand Customs Service produces services relating to the surveillance of international airports, waterfronts, coastlines, sea approaches, and the international mail, together with the searching of air and sea passengers, baggage, cargo, aircraft, vessels and mail items, in order to prevent the entry and exit of, or to detect, prohibited and restricted items. These items include drugs, firearms and other weapons, pornography, substances dangerous to the ozone layer, intellectual property right breaches, various unsafe products and endangered species."

² The Working Group comprised of officials from the State Services Commission, Treasury and NZ Customs Service, and led by an SSC official.

An initial ranking of 1, 2, or 3 was assigned to reflect weak, moderate or strong causal links, respectively (NZCS, 1997b). While this matrix provided a general indication of the strength of the links between Customs outputs and Government outcomes, it did not provide any insights into 'how' these outputs affected or influenced the outcomes.

Table 1: Matrix of some of Customs Output / Outcome Relationships

OUTPUT SPECIFICATIONS	OUTCOMES SOUGHT FROM CUSTOMS INTERVENTIONS							
	Government tax regimes are complied with	Reliable trade data is available for analysis by business and policy Ministries.	Dumped and subsidised goods do not enter the country on terms determined to be damaging to New Zealand Industry.	Deceptive goods do not enter the country on terms determined to be damaging to New Zealand consumers.	Immigration to New Zealand is managed in accordance with the national interest.	A market for hard drugs does not become significant in New Zealand.	Illicit markets for pornography do not become significant in New Zealand	New Zealand complies with international convention in relation to combating money laundering.
1.1 Check & Clear Arriving Air Passengers & Crew	1				3	3	2	3
2.1 Check and Clear Import Entries	3	3	3	1			1	
3.1 Surveillance					3	3	3	
3.2 Search				3	3	3	3	3
5.2 Audit	3	2	3	2				
5.3 Compliance Checks	3	3	3	3			3	
6.1 Drug Investigations						3		2
6.4 Intelligence	3		2	3	2	3	2	2
8.2 Advisory Services	2							

Causality

1 = Low

2 = Medium

3 = High

A valuable innovation was then tried - spiderweb diagrams. One set focussed on outputs and showed how many outcomes each output contributed to (see Figure 2 for example). Another set (eg Figure 3) focussed on outcomes and showed how many outputs each outcome relied upon.

In the event, while these proved useful working documents, there was still something missing. Although both the matrix and the spiderweb diagrams indicated the direction of the relationships between outputs and outcomes, they could not allow the strength and the nature of the existing and potential interactions to be analysed, taking into account both tangible (hard data) and intangible (soft) factors.

Consequently, it was agreed that the system dynamics modelling methodology be trialled in an attempt to bring qualitative/holistic elements and the quantitative elements into one picture. This position was consistent with the direction of the reforms of public sector management in New Zealand (Boston and Pallot, 1997, p400):

“The new strategic management framework suggests that the importance of soft information and soft analysis, which seeks to pose the right questions rather than find the right answers, is now beginning to be appreciated”

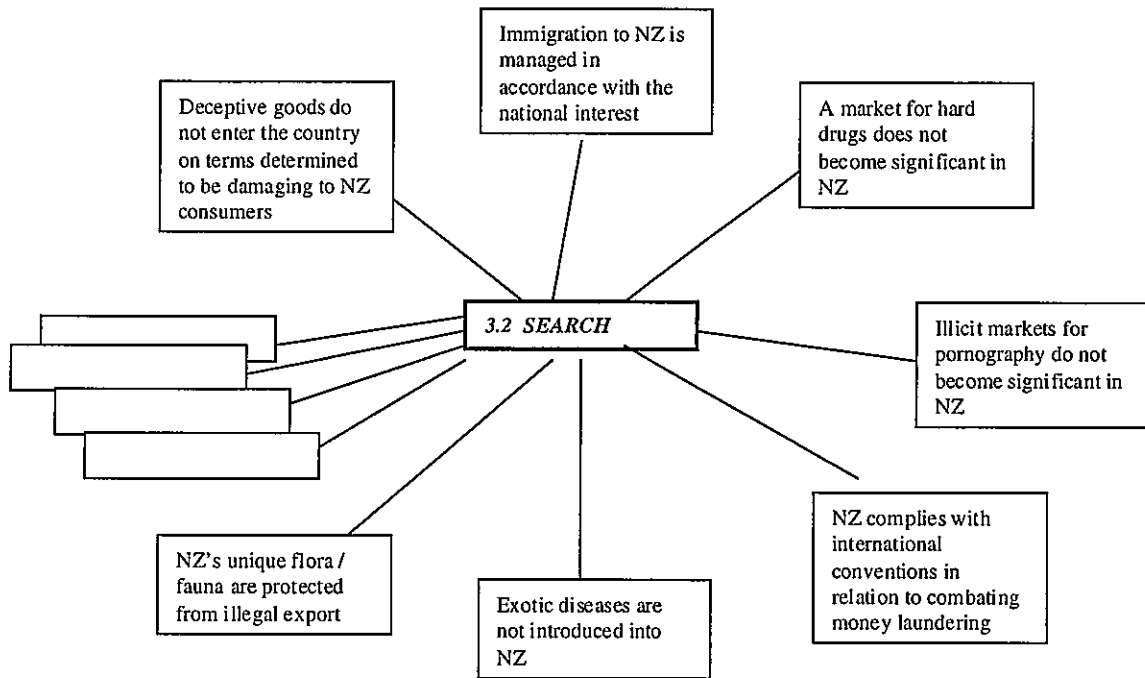


Figure 2: Linkages between Customs Search Output and Government Outcomes

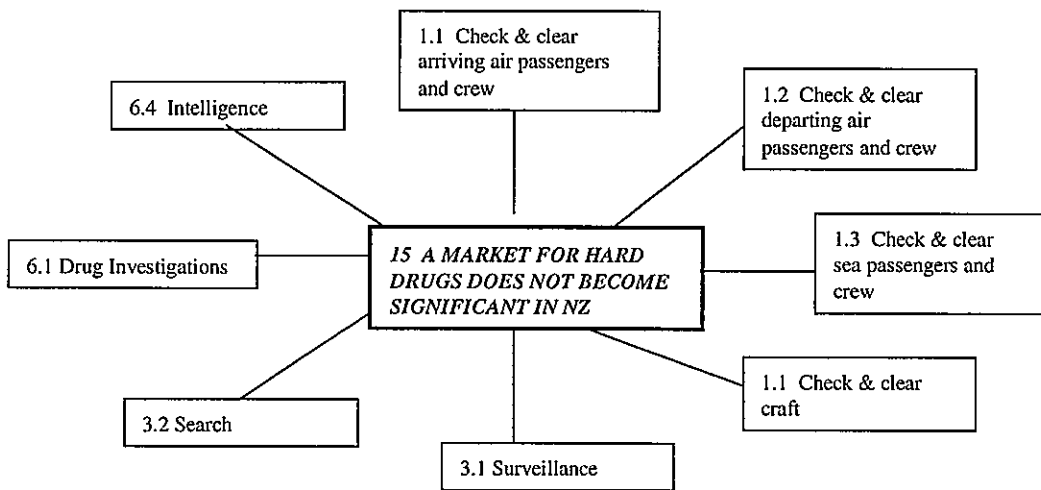


Figure 3: Relationships between Customs Outputs and the Government Outcome "a market for hard drugs does not become significant in NZ"

The System Dynamics Pilot Study

The Baseline Review Working Group had done some work on analysing the risks associated with Customs' revenue collection and community protection activities (NZCS, 1997a & b). It has also prepared a matrix looking at possible causal relationships between Customs outputs and the outcomes to which they contribute (see Table 1 above). The next step was to test the strength of the causal relationships and analyse the sensitivity of the outcomes to changes in the quantity and/or quality of outputs, in order to determine the desired purchase mix.

Given the large number and complexity of output-outcome interactions, and the preference to capture both soft issues and hard data, it was considered that the traditional analytical techniques would be of limited use. As an alternative tool, the Working Group expressed interest in exploring the application of strategic modelling, using the system dynamics methodology, through a pilot study. Victoria Link Ltd, the consulting arm of Victoria University of Wellington, agreed to collaborate with this pilot study. This involved working with a sub-group of the Baseline Review Working Group. It should be noted at this stage that the time allowed for this pilot study corresponded to 10 working days, with the study to be completed within a very tight time frame (commencing on a part time basis on 11 September and to be completed in October 1997).

The pilot study³ was performed on Output Class 3: Search & Surveillance. However, the focus of the study was on the Search for prohibited items (particularly drugs) in output class 3.2, which had a purchase budget of NZ\$10.95 million in 1996/97, equivalent to 21% of the total value (NZ\$51.5 million) of the Customs budget in that year (NZCS, 1996a). Within the Search output class, the NZ Customs "undertakes search related duties covering air and sea passengers and crew, international mail, craft, cargo, places, premises and persons" (NZCS, 1996a, p24).

Full details of the system dynamics methodology are provided by Forrester (1961), Coyle (1996), and Mohapatra *et al.* (1994). Wolstenholme and Coyle (1983) provide a comprehensive guide to constructing influence diagrams. A number of definitions of the system dynamics methodology are available, but the one recently provided by Eric Wolstenholme (1997) is most appropriate. Wolstenholme describes the scope of system dynamics as:

"What: A rigorous way to help thinking, visualising, sharing, and communication of the future evolution of complex organisations and issues over time;

Why: for the purpose of solving problems and creating more robust designs, which minimise the likelihood of unpleasant surprises and unintended consequences;

³ The original Baseline Review was intended to cover all outputs from Customs activities. However, this proved to be too large, and a lot of the Baseline Review effort went into the search and surveillance activities. Hence it was decided that the system dynamics pilot study should consider some activities (eg search for drugs) within these output classes for illustrative purposes.

How: by creating operational maps and simulation models which externalise mental models and capture the interrelationships of physical and behavioural processes, organisational boundaries, policies, information feedback and time delays; and by using these architectures to test the holistic outcomes of alternative plans and ideas; and

Within: a framework which respects and fosters the needs and values of awareness, openness, responsibility and equality of individuals and teams."

Development of System Diagrams for the Pilot Study

Overview Diagrams

Most of the work was undertaken at the Customs premises in close collaboration with Customs officials. Significant progress was made, particularly at the conceptual and systems mapping end of the study. A number of diagrams were developed, including those listed below. Some of these are presented here:

- An overall sector diagram showing the relationships between Customs inputs and outputs, and the outcomes expected by Government (Figure 4);
- A simplified influence diagram showing the linkages between the craft and vessels sub sector and the impacts of the drug market on New Zealand society (Figure 5);
- A series of influence diagrams for each of the aggregated Customs locations involved with drug search activities, ie sub sectors for the mail centre, craft and vessels (rummaging), sea cargo, air cargo (and couriers), and airports (passengers and baggage);
- A Powersim (1994) stock flow diagram for the craft and vessels sub sector; and
- A Powersim diagram for the flow of illegal drugs in New Zealand (Figure 6).

These diagrams were discussed with the Working Group officials on 26 September 1997. It became clear at that meeting that the project team had approached the study as an examination of the linkages between inputs, outputs and outcomes, thus reflecting the Customs managerial priorities, rather than the Minister's perspective of the purchase agreement with Customs (i.e. the links between outputs and outcomes). However, this approach was not surprising since the 1996/97 Purchase Agreement contained a lot of measures related to officer days and drug detector dogs (i.e. inputs) (NZCS, 1996a).

In the Powersim stock flow diagram, the boxes (rectangles) represent stocks or levels and the circles attached to double lines in or out of stocks represent flows or rates. For example in Figure 6, the stock 'drugs at NZ border' represents the quantity of drugs at any point in time at the border, ie in the international mail room, on vessels or craft, in cargo at the air or sea ports, or on passengers or in their luggage at the air or sea ports. Also the flow 'drugs seized at border' indicates the quantity of drugs per period (eg month, quarter, year) that have been seized during the specified time interval.

Figure 6 represents the physical flow of drugs in New Zealand. If sufficient data were available this model could be developed to include all the variables and relationships shown in the 'illicit drugs' influence diagrams (see Figures 5 & 7).

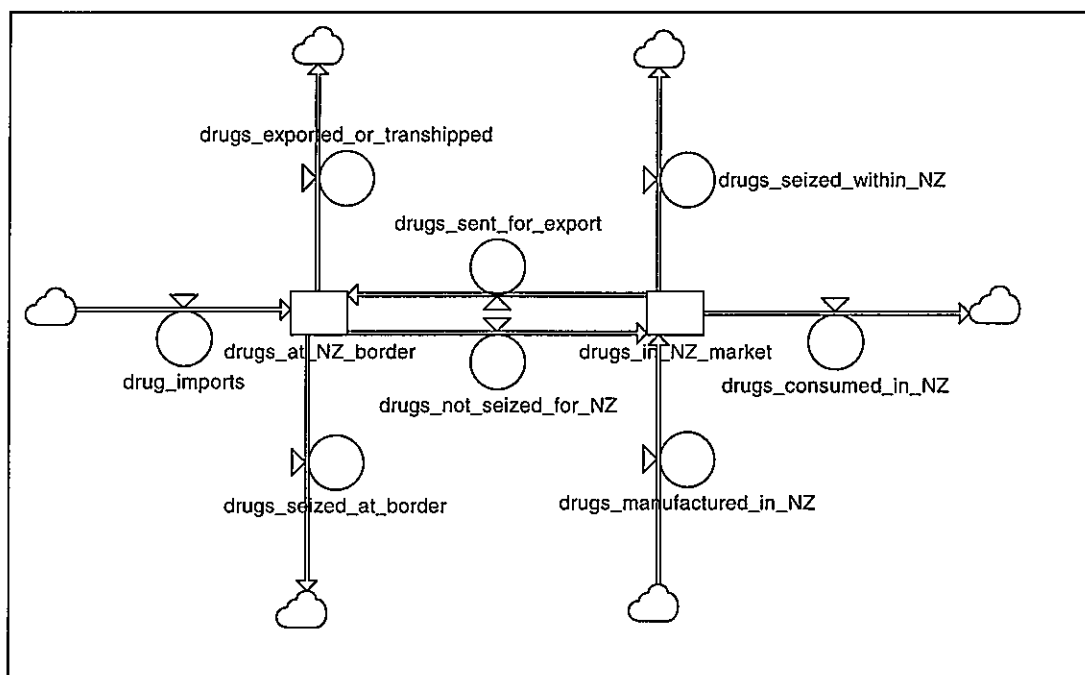


Figure 6: Powersim Stock Flow Diagram for Illegal Drugs in NZ

Detailed Influence Diagrams

Following the progress review meeting, we began developing more detailed influence diagrams exploring the linkages between Customs outputs and Government outcomes in New Zealand. These cover 20 of the 21 “desired outcomes” identified in the “community protection and non-revenue risks” paper produced by the working group earlier in the year (NZCS, 1997a). These diagrams provide a much broader sense of the issues involved in making decisions about the “mix” of outputs which the Minister of Customs may wish to purchase from the NZ Customs Service.

Figure 7 relates to Strategic Result Area (SRA) 6 (safer communities). It relates to one of six risks identified for that SRA - in this case the risk of illicit drugs, for which the desired outcome is that a market for hard drugs does not become significant in New Zealand.

Note that the legislation identified at the top of the diagram specifies what constitutes "hard drugs" and that the emphasis given these by the New Zealand Customs Service is indicated by the distinction between all class A drugs, but only those class B drugs which are in quantity for supply.

When a number of influence diagrams were laid out together, the significance of particular Customs capabilities became clear. For example, the capability in giving attention to arriving vessels and craft appeared in a number of the diagrams prepared. For the risk of illicit drugs, the results of 'check and clear craft', along with 'intelligence' which is driven by 'international liaison' and the 'informant handling programme', allows the National Shipping Office to recommend cost effective responses to perceived risk. That is to say, a decision on whether to 'rummage' or to use 'surveillance'.

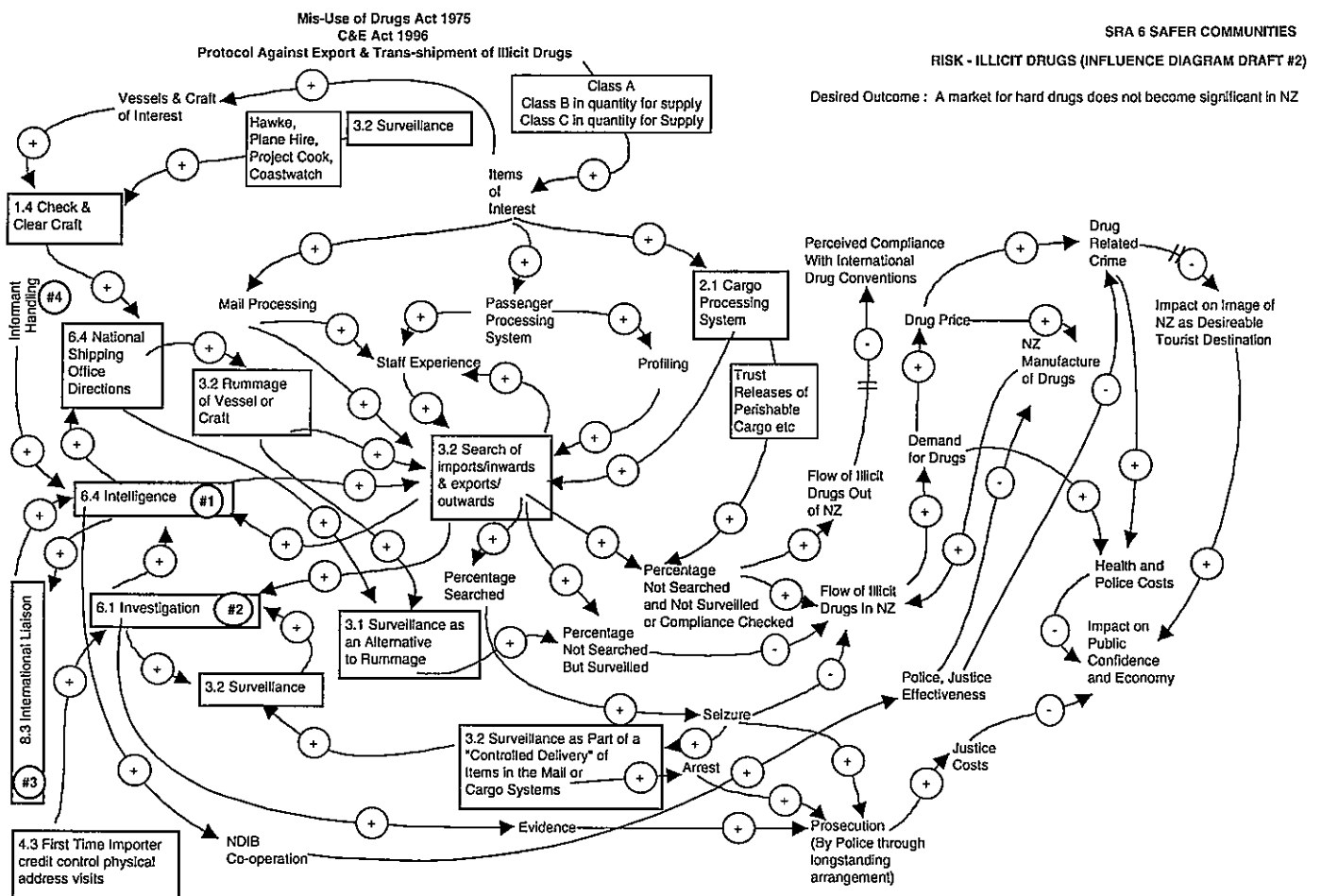


Figure 7: Influence Diagram for Strategic Result Area: Risk of Illicit Drugs in NZ

This diagram is unusual in terms of the number of times the surveillance technique (see boxes 3.2) may be applied (four). Nine outputs are involved in the accomplishment of the objective, and it is interesting to note that these do not include prosecution - which is handed over to the Police to do through a long standing arrangement.

Ideally a simulation model would be developed using an influence diagram like Figure 7. However, this does contain moderately detailed level of information, and modelling would normally commence with a more simplified diagram like Figure 5. However, it was not possible to model even the simplified version of the diagram due to a lack of outcome related impact data. One should not be surprised at this. The generic gaps faced by Customs are mirrored elsewhere throughout the New Zealand public service and are well known to central agencies.

Data Collection and Analysis

Customs Data

For the remainder of this pilot study, we concentrated on trying to collect data so we could develop a quantitative system dynamics model of the linkages between the search for drugs by Customs and the wider impacts in New Zealand society - unfortunately without much success.

Due to the lack of essential Customs data, we realised that it would not be possible to construct a quantitative model of the type proposed in the pilot study terms of reference. However, we still attempted to collect the relevant drug outcomes data.

National Drug Intelligence Bureau Data

We visited the NZ National Drug Intelligence Bureau (a joint operation of Police, Customs and Health Departments) to collect data and discuss the project. While the NDIB have some excellent statistics on drug seizures (eg NDIB, 1997) and the profiles of people arrested, they have much less reliable data on the size of the NZ market, imports and exports of drugs, NZ manufacture of drugs, and domestic consumption. We were advised not to hurriedly put a pilot quantitative model together, as not enough research had been done on the basic relationships underlying the patterns of drug supply, consumption and distribution in the drug markets in New Zealand.

Statistical Analysis and Sampling

To develop a system dynamics model involving drug search/outcome relationships, we needed some reliable long term data related to Customs searches and the potential outcomes in society. There was a lack of :

- any previous statistical studies analysing the relationships between drug search activities and government outcomes;
- relevant available Customs data; and

- wider relevant societal data in other agencies.

It was agreed that we should not continue with attempts to develop a quantitative model of 'Drug Search'. This was the same conclusion reached by Coyle and Alexander (1997, p206) in their paper on the qualitative modelling of a nation's drug trade:

"Sometimes, a given problem is effectively "solved" in the sense that the insights from the diagram are so convincing that managers are prepared to act on them without a quantified analysis. In other cases, and the work described in this paper is one of them, the uncertainties in the numerical data are so great that a quantified model may contain such uncertainties and inaccuracies that it is not worth the effort of building."

Nevertheless, it was worth trying to develop a quantitative system dynamics model as the process revealed the inadequacies in the availability of data for strategic purposes.

Related System Dynamics Studies of Drug Activities

Although we did not have sufficient time to undertake a detailed literature review of drug related studies using the system dynamics methodology, we did locate some studies that will be valuable for further research in this area. These include the paper referred to above by Coyle and Alexander (1997) in the *System Dynamics Review* on "Two approaches to qualitative modelling a nation's drug trade". The two approaches were by developing 'influence diagrams' and 'rich pictures'. A rich picture (Checkland, 1981) is a picture or situation summary, that focuses attention on the main variables and issues involved in the system. Coyle and Alexander (1997, Fig 5, p219) provide a rich picture of the Dystopia (a hypothetical country) drug trade, which superbly illustrates the complexity of the system we were trying to model in this pilot study. This rich picture is reproduced in the Appendix to this paper.

Also recent research by Gardiner and Shreckengost (1987) and Homer (1993) has indicated some success with constructing system dynamics models of drug related activities in the USA. Gardiner and Shreckengost's research, which involved developing a system dynamics model for estimating heroin imports into the United States was particularly useful "*in the way in which the model has been used to flag inconsistencies and fill gaps in federal data*". This model builds on earlier system dynamics models, and in particular the "Persistent Poppy" by Levin, Roberts and Hirsch (1975).

Homer (1993, p76) has warned that his model of cocaine prevalence in the USA should not be used as an accurate forecasting tool. He suggests that the model could "*have value as a tool for improving understanding of national cocaine prevalence trends and policy impacts. It may also be useful as a starting point for further studies of illicit drug use and drug market dynamics*".

These studies provide some useful guidance for more indepth research involving drug related modelling for the New Zealand situation.

Concluding Comments

Conclusions from the Pilot Study

In general, Treasury and the State Services Commission were not entirely pleased with the results of the pilot study, because they had wanted a quantitative analysis as well as a qualitative one. However, this study has supported the conceptual and empirical difficulties with identifying and measuring output/outcome relationships, which had been fully emphasised recently by eminent international scholars, Schick (1996) and Pollitt (1997), during their visits to New Zealand. Also recent work by SSC (1998a & b) has examined some of the wider problems associated with measuring outcomes. On the other hand Customs regarded the pilot study as being highly successful despite not completing a quantitative computer model. This was because the study had:

- developed a range of detailed influence diagrams exploring the linkages between Customs outputs and Government outcomes in New Zealand. These cover 20 of the 21 'desired outcomes'. These diagrams provide a much broader sense of the issues involved in making decisions about the 'mix' of outputs which the Minister of Customs may wish to purchase from the NZ Customs Service;
- developed a number of influence diagrams and Powersim stock flow diagrams that explore the linkages between Search inputs and outputs, and associated societal outcomes.
- indicated that Customs should increase its collaborative work with other agencies with shared "responsibilities" for specific outcomes, eg with NDIB, Police, Health and Justice over drug related issues;
- established that more specific 'intermediate' outcome measures (or "indicators of direction"), in addition to the wider societal outcomes, should be systematically identified, measured and monitored to help evaluate the effectiveness of the Customs Service;
- identified a range of strategic data requirements related to Customs search activities, that should be collected and examined by the Customs strategic analysis group; and
- observed that there is a lack of data and statistical analysis of the historical relationships between Customs outputs and outcomes.

In short, using the influence diagrams Customs found a ready way to present the "feel" of what it does for the Government, and to see then what type of information it should be gathering or accessing not only if it was to present a plausible case for funding but also to manage its business better towards the outcomes desired by the Government. For Customs, the soft/qualitative analysis was persuasive enough.

In addition, the pilot study has demonstrated that the system dynamics methodology is an extremely powerful and useful framework that can help the Government "*break through long-standing and complex policy problems*" (East, 1997, p7). Also the qualitative mapping methods outlined could provide an approach to help address some of the concerns expressed by Scott *et al.* (1997, p364) when considering systems of public

management: “*In an ideal situation all the linkages between inputs, outputs, and outcomes would be known...* ”

Thinking Shift – Need for Strategic Alignments and Relationships Recognised

The Pilot Study had been a ‘final’ attempt to meet the requirements of all parties to the tri-partite Baseline Review. With the mixed reception to the results of the pilot, the Review washed up with the difficult task of telling Cabinet Ministers that the fundamental dispute that had led to the review still remained.

During the Baseline Review, Customs reached the conclusion, that to be successful in its business and contribute usefully to the outcomes desired by the Government, it needed to reach out to the policy ministries whose purposes it serves. These strategic relationships would allow Customs to revisit its tasks with fresh eyes. They would allow Customs to design fresh solutions to the risks, rather than merely “make what it does, fit the headings”.

Using different pathways all the members of the tripartite review concluded Customs needed to demonstrate that its outputs were strategically aligned from a Government perspective. Customs commenced a Strategic Business Review.

Strategic Business Review/Strategic Business Plan

The systems thinking approach carried on into a strategic business review which produced a strategic business plan. That plan has ended up addressing both the concerns of Customs (ownership interests included) and the concerns of the central agencies. The Treasury, the State Services Commission and the Customs Service expects the result will be more objective discussions between the NZCS and its Minister on purchase mix decisions and on the capabilities to be maintained.

Subsequent Steps - Need for Strategic Alignments and Relationships Being Addressed

The Strategic Business Plan for the New Zealand Customs Service is in the process of implementation. A Strategic Policy Unit has been created which, *inter alia*, will address:

- a framework for the strategic analysis of NZCS input/output/outcome relationships; and
- a framework for strategic alignments and relationships between the NZCS and other agencies.

Early thinking has been that the framework for strategic analysis needs to take account of the fact that there are “clusters” of agencies who share a strategic or operational interest in an outcome. An illustration of the “strategic cluster” relating to illicit drugs appears as Figure 8.

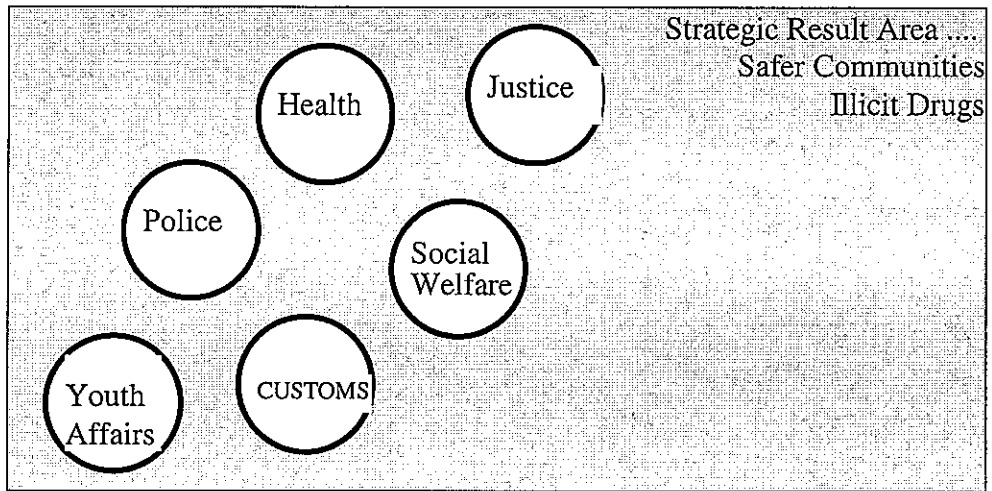
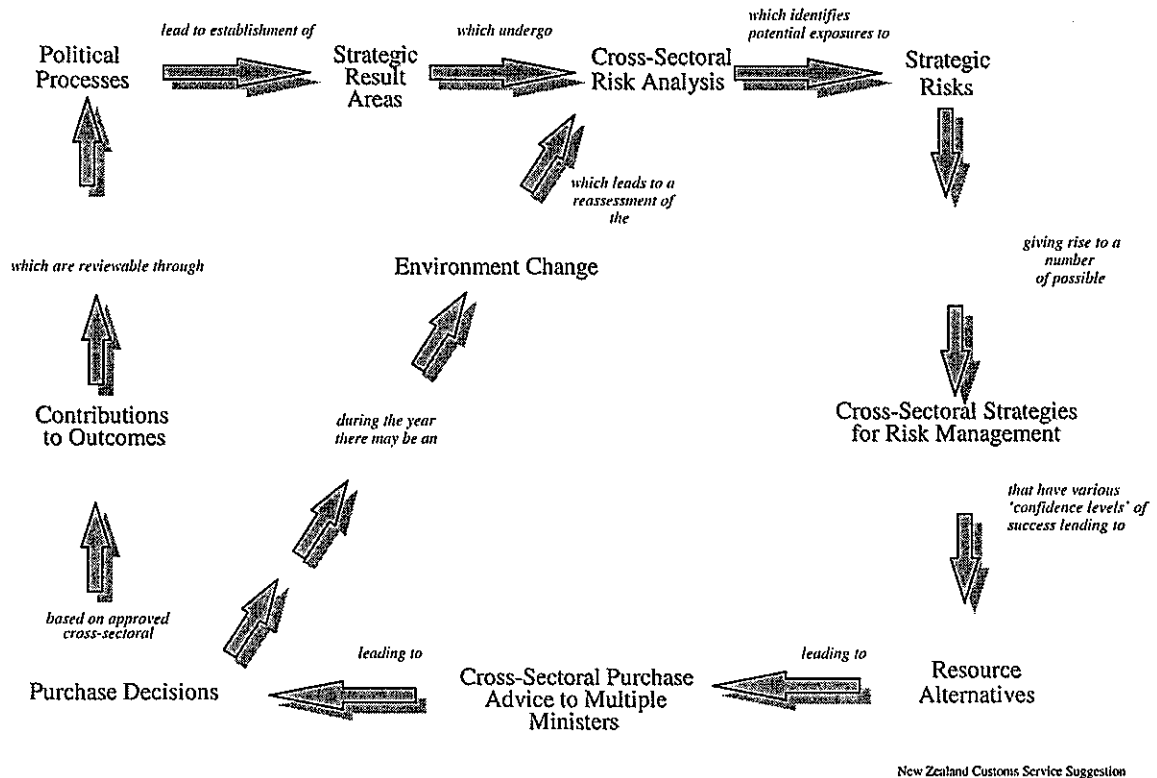


Figure 8: Illustration of Potential Clusters of Government Agencies

A logical consequence of this thinking is that there is also a need for a cross-sectoral (inter-agency) risk management process for interventions designed to manage the risks to the outcomes. The concept presently under consideration appears as Figure 9.

Subsequent and co-incidental to the development of NZCS thinking about strategic clusters, the Prime Minister of New Zealand has announced some changes to the way Cabinet will operate. The change sees “clusters” (or ‘networks’) of agencies with some common interests, reporting to a senior Cabinet Minister charged with accomplishing coordination of policy and service delivery components of particular strategic result areas (SSC, 1998b). The New Zealand Customs Services has been allocated to a “cluster” of Government agencies reporting to the Minister of Food, Fibre, Bio-Security and Border Protection.



New Zealand Customs Service Suggestion

Figure 9: Cross-Sectoral Risk Management Process

Overall Conclusions From the Shift Towards Systems Thinking

State sector reforms deliberately separated policy evolution and the associated service delivery, with agencies taking their cue from politically established “strategic result areas” to determine what outcomes they should contribute to. The pilot study of the system dynamics methodology highlighted that, in fact, there is - for the New Zealand Customs Service at least - a multiple inter-connectedness between policy agencies and service providers and exogenous factors, which impacts the ability to measure any progress towards accomplishing an array of outcomes. Subsequently all parties involved have gained insights from the studies and have made thinking shifts.

These led to a strategic business review and the establishment of a strategic business plan which aims to position the Customs Service to maintain capability and to deliver services effectively and cheaply. The establishment of a strategic policy unit is core to the changes being made. The unit is already using a systems thinking approach to externalise its previously internal conceptual models of inter-connectedness. This development is coincidental to a growing political interest in grouping agencies with enough similar interests, into clusters capable of coordinating activities to make visible progress in areas of strategic importance to the Government (SSC, 1998b). Clearly there

is an emerging awareness of the importance of looking at problems from a holistic, systemic perspective rather than a jurisdictional one.

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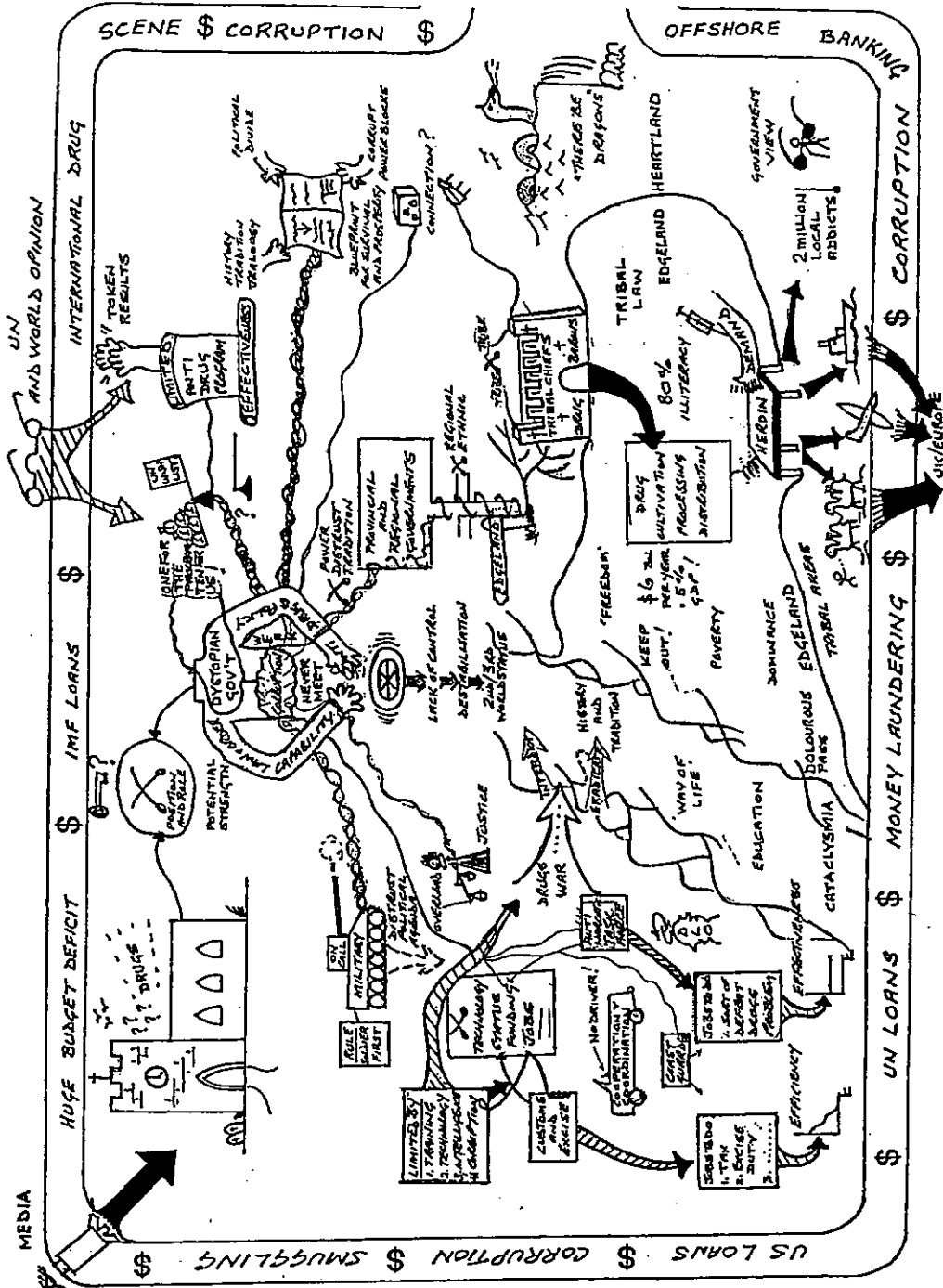
References

- Boston, J. and J.Pallot 1997. Linking strategy and performance: Developments in the New Zealand public sector. *Journal of Policy Analysis and Management* 16(3), 382-404.
- Boston, J., J.Martin, J.Pallot and P.Walsh (eds.) 1991. *Reshaping the State: New Zealand's Bureaucratic Revolution*. Auckland, New Zealand: Oxford University Press.
- Boston, J., J.Martin, J.Pallot and P.Walsh (eds.) 1996. *Public Management: The New Zealand Model*. Auckland, New Zealand: Oxford University Press.
- Checkland, P. 1981. *Systems Thinking, Systems Practice*. Chichester, UK: Wiley.
- Coyle, R.G. 1996. *System Dynamics Modelling: A Practical Approach*. London: Chapman & Hall.
- Coyle, R.G. and M.D.W.Alexander 1997. Two approaches to qualitative modelling of a nation's drugs trade. *System Dynamics Review* 13(3), 205-222.
- East, P. Hon 1997. *From outputs to outcomes*. Address by the Minister of State Services, Public Service Senior Management Conference, Wellington, 9 October 1997.
- Evans, L., A.Grimes and B.Wilkinson, with D.Teece 1996. Economic reform in New Zealand, 1984-1995: The pursuit of efficiency. *Journal of Economic Literature* 34, 1856-1902.
- Forrester, J.W. 1961. *Industrial Dynamics*. Cambridge, Mass: MIT Press.
- Gardiner, L.K. and R.C. Shreckengost 1987. A system dynamics model for estimating heroin imports into the United States. *System Dynamics Review* 3(1), 8-27.
- Homer, J.W. 1993. A system dynamics model of national cocaine prevalence. *System Dynamics Review* 9(1), 49-78.
- Levin, G., E.B.Roberts and G.B.Hirsch 1975. *The Persistent Poppy*, Cambridge, Mass: Ballinger.
- Mohapatra, P.K.J., P. Mandal and M.C. Bora 1994. *Introduction to System Dynamics Modelling*. Hyderabad 500 029: Universities Press (India) Ltd.

- NZCS 1996a. *Schedules to PURCHASE AGREEMENT 1996/97: Between the Minister of Customs and the Chief Executive of New Zealand Customs Service*, New Zealand Customs Service, Wellington, New Zealand.
- NZCS 1996b. *Risk Mail Action Plan: 1996-1997*. International Mail Centre, New Zealand Customs Service, Auckland, New Zealand.
- NZCS 1997a. *Outcomes and risk assessment: community protection and other non-revenue risks*. NZ Customs Service Baseline Review, Paper No. 4, version 7, 15 July 1997, New Zealand Customs Service, Wellington, New Zealand.
- NZCS 1997b. *A preliminary analysis towards determining the desired purchase mix*. Unpublished memo of the Customs Baseline Review Working Group, State Services Commission, Wellington, New Zealand.
- Pollitt, C. 1997. *Looking outcomes in the face: the limits of Government action*. Address to the Public Service Senior Management Conference, Wellington, New Zealand, 9 October 1997.
- Powersim 1994. *User's Guide and Reference*. Norway: ModellData AS.
- Schick, A. 1996. *The spirit of reform: managing the New Zealand state sector in a time of change*. State Services Commission, Wellington, New Zealand.
- Scott, G., I.Ball and T.Dale 1997. New Zealand's public sector management reform: Implications for the United States. *Journal of Policy Analysis and Management* 16(3), 357-381.
- SSC 1998a. *Assessment of the State of the New Zealand Public Service*. Occasional Paper No. 1. State Services Commission, Wellington, New Zealand.
- SSC 1998b. *A Better Focus on Outcomes through SRA Networks*. Occasional Paper No. 3. State Services Commission, Wellington, New Zealand.
- Treasury 1995. *Purchase Agreement Guidelines: With Best Practices for Output Performance Measures*. April, 1995. The Treasury, Wellington, New Zealand.
- Wolstenholme, E.F. and R.G. Coyle 1983. The development of system dynamics as a methodology for system description and qualitative analysis. *Journal of the Operational Research Society* 34(7), 569-581.
- Wolstenholme, E.F. 1997. REPLY System Dynamics in the elevator (SD1163), email reply to "system dynamics" system-dynamics@world.std.com, 24 Oct 97, from Eric@Cognitus.co.uk.

Appendix

Rich picture for the Dystopia drugs trade



Source: Coyle and Alexander, 1997, Figure 5, p219.

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