RISK MANAGEMENT STRATEGY IN AUSTRALIAN FEDERAL GOVERNMENT: CRITICAL ANALYSIS WITH SYSTEM DYNAMICS APPROACH

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Abstract

Risk Management Strategy provides an overview of the processes directed at reducing risk and capturing opportunities. It outlines processes and techniques to enhance the efficiency of risk management. A formalised, well-structured and systematic approach to risk management is essential to ensuring the continuing success of the programmes and the achievement of the programme objectives. Better management of risk and more successful activities are the expected outcomes.

Managing risk is an integral part of sound management, and fundamental to achieving programme objectives. Risk management activities take many forms, and although most managers do not use the term 'risk' when they undertake these activities, the concept of risk is central to what they are doing.

In this sense, this paper examines the concept of risk, the objective and policy of risk management, the strategy and the generic procedure. Also as a case study, the Risk Management Strategy of Tax Concession Program in Australian Federal Government is analysed with System Dynamics perspective.

Keywords: *risk management, tax concession, system dynamics, and Australian Government system*

1. Introduction

"Risk Management is the term applied to a logical and systematic method of establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risks associated with any activity, function or process in a way that will enable organisations to minimise losses and maximise opportunities."[1] Essentially, it involves identifying and undertaking courses of action to support the achievement of organisational goals.

[1] As defined by Australian New Zealand Standard on Risk Management (AS/NZS 4360: 1999). AS/NZS 4360 has been widely adopted by industry and within the public sector in Australia.

Decisions about managing risks need to be consistent with the organisation's internal and external environment, that is, the strategic context[2]. The risk management strategy must support the organisation's values of making merit-based decisions, having the highest ethical standards, being accountable for actions, delivering services fairly, effectively, impartially and courteously, being responsive to the Government in providing frank, honest, comprehensive, accurate and timely advice and implementing the Government's policies and programs (Billington, 1997).

The structure of the risk management strategy consists of the following main components (Broadleaf Capital International, 1999a [3]).

- The overall Risk Management Strategy outlines the risk management responsibilities and the process as it is to be applied. It also points to the Risk Management Framework and how the risk management process is to become an ongoing part of the operations of all the parties involved.
- The Risk Management Framework describes the specific processes to be adopted by various groups.
- The current Risk Assessment and Management Plan describes the process by which the current risk profile was obtained, the major risk areas and the key recommendations to reduce and manage them, and provides the link to the Risk Register and Risk Action Plans.
- The Risk Register and Risk Action Plan Summaries contain a comprehensive list of the risks, their current controls and the recommended actions to address the high-priority risks.

Managing risk is an integral part of sound management, and fundamental to achieving programme objectives. Risk management activities take many forms, and although most managers do not use the term 'risk' when they undertake these activities, the concept of risk is central to what they are doing.

A formalised, well-structured and systematic approach to risk management is essential to ensuring the continuing success of the programmes and the achievement of the programme objectives. The risk management strategy provides an overview of the activities directed at reducing risk and capturing opportunities. It also assists by defining formal techniques to enhance the efficiency of the process. Better management of risk and more successful programme activities are the expected outcomes.

In this sense, this paper examines the objective and policy of risk management, the strategy and the generic procedure. Also as a case study, the Risk Management Strategy of a program in Australian Federal Government is analysed and reviewed from System Dynamics perspective.

[2] Establishing the context is the first stage of risk management, as described by AS/NZS 4360.

[3] Broadleaf Capital International (BCI) is a consulting agency specialising in risk management. BCI have been principal advisors to Standards Australia and New Zealand during development of the current and earlier versions of AS/NZS 4360.

2. Risk Management Strategy in Australian Public Sector

The strategy is the integration of the risk management process with the routine operations. The purpose of this process is to ensure that:

- All significant risks to the success of the programmes;
- Identified risks are understood, with both the range of potential consequences they represent and the likelihood of values in that range being determined as far as is necessary for decision making;
- Assessment is undertaken of individual risks relative to the other risks to support priority setting;
- Strategies for treating the risks take account of opportunities to address more than one risk;
- The process itself and the risk treatment strategies are implemented cost effectively.

The recommended process to be adopted follows the steps in the Australian/New Zealand Standard on Risk Management AS/NZS 4360: 1999. This is consistent with the process described in MAB/MIAC Report No. 22, Guidelines for Managing Risk in the Australian Public Sector. Figure 1 shows the general process of this (AusIndustry, 2001).

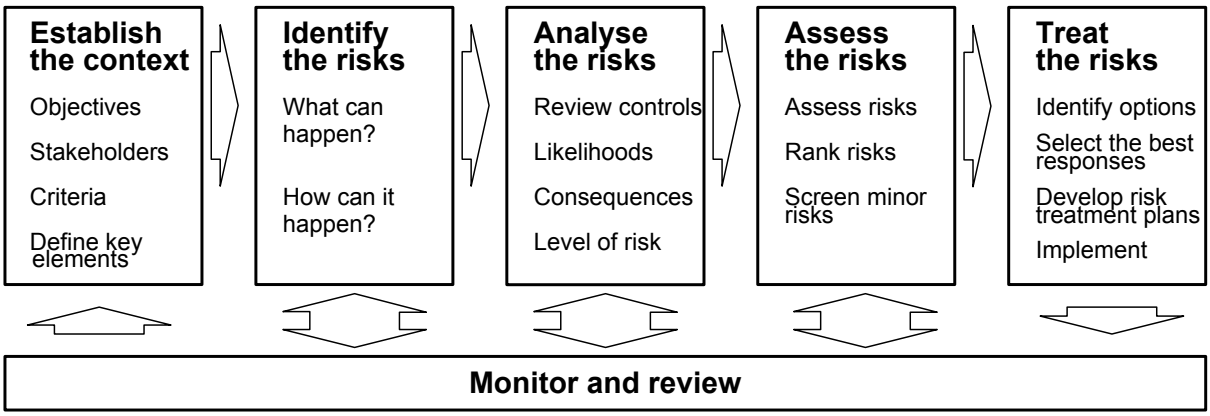

Figure 1. General Process of the Risk Management in Australian Public Sector

2.1 Establishing the Context

Risk identification is often seen as the heart of risk management. To be able to recognise a risk it is necessary to know what is at risk. The first step in the process is to define the context of the risk, setting the scene for a cost-effective risk identification process: identification is strongly context dependent.

Establishing the context is concerned with developing a structure for the risk identification and assessment tasks to follow. It has several purposes (Broadleaf Capital International, 1999a):

- To establish the organisational environment in which the risk assessment is taking place;

- To specify the main objectives and outcomes required;
- To identify a set of success criteria against which the consequences of identified risks can be measured; and
- To define a set of key elements for structuring the risk identification and assessment process.

Where parts of the organisation such as the individual programmes are to be examined, it is common sense as well as good practice to understand the relationship between their objectives and those of the larger organisation. Checking the alignment between objectives at various levels in the organisation ensures that no important assumptions or unspoken objectives are ignored.

Objectives lie at the heart of the context definition, and they are linked into the risk management process via criteria for measuring success. Success criteria are the basis for measuring the achievement of objectives, and so are used to measure the impact of anything that might jeopardise those objectives, the consequences of risks (Broadleaf Capital International, 1999). To be effective, success criteria must:

- Be concise, providing a manageable number of measures that allows all significant impacts to be assessed;
- Cover all aspects of success, so all significant impacts are measured;
- Separate the impact of a risk from the likelihood of its occurrence.

Success criteria should not be confused with key performance indicators (KPIs). KPIs may include success criteria or equivalent measures, but they might also incorporate monitoring variables that serve a diagnostic purpose rather than indicating success or failure.

Risk identification will generally be unproductive if an attempt is made to consider an organisation as a whole. It is much more effective to disaggregate it into sections or key elements for risk identification.

Key elements are a set of topics to be considered one by one during risk identification. Each topic is somewhat narrower than the concept of the organisation as a whole, allowing those performing the identification to focus their thoughts and go into more depth than they would if they tried to deal with the whole organisation in one go. A well-designed set of key elements will stimulate creative thought, and ensure that all-important issues are put before those responsible for identifying risks. When a brainstorming meeting is used to identify risks, the key elements form the agenda and the basis of the timetable for that meeting (Grey, 1999).

The set of key elements must be complete, in that it covers all significant issues. However, as the number of key elements tends to drive the duration of the risk identification activity, it must also be contained to an appropriate scale. It must balance sufficient specific language to stimulate the identification of risks against enough generality to avoid prejudging the identification process.

2.2 Risk Identification

Risk identification is best conducted as an iterative, group-based activity. However, it can involve reviews of documents, examinations of processes, Nominal Group Technique, brainstorming exercises, facilitated elicitation workshops, and cognitive mapping (McLucas, 2001: 64-123). It should be structured using the key elements to examine risks systematically, in each area of the organisation to be addressed.

The current risk identification used a combination of:

- Document review, including results of previous risk identification activities;
- Brainstorming workshops;
- Failure modes and effects analysis of the main processes;
- Interviews with key individuals.

2.3 Risk Analysis

The analysis stage assigns each risk a significance rating, taking into account identified factors that could bring an event to fruition. For many simple risks, the risk can be expressed as an uncertain event. However, some uncertainties do not lend themselves to being described as events. For instance, a particular type of client behaviour leading to low compliance might be expressed as an event for a single client: for example, the client will or will not engage in a certain non-compliant practice. Where there is a large number of similar clients and it is impracticable to address each one separately in the risk analysis, the risk might be best described in relation to an estimate of the total level of non-compliance in the industry, not an uncertain event but an uncertain quantity. The risk might then be expressed in terms of the level of non-compliance exceeding programme expectations (AusIndustry, 2001).

The significance of a risk can be expressed as a combination of its likelihood and impact. Likelihoods and corresponding consequences, or potential impacts, are rated according to qualitative five-point scales. See Table 1, below.

Rating Scales	**LIKELIHOOD** The potential for problems to occur	**POTENTIAL IMPACT** In terms of the criteria
A	VERY HIGH: Almost certain, will occur at least several times per year	VERY HIGH: most criteria may not be achieved
B	HIGH: Likely to arise about once per year	HIGH: most criteria threatened or several may not be achieved
C	MODERATE: Possible, may arise at least once in a ten year period	MODERATE: some criteria affected
D	LOW: Unlikely but not impossible, has about a 10% chance of occurring over the next five to ten years	LOW: Minor, can be remedied with some adjustment to resources
E	VERY LOW: Rare, very unlikely but possible	VERY LOW: Negligible consequences, can be handled by existing resources

Table 1. Five-point Likelihood and Impact Scales

The likelihood and impact assessments are converted into a risk priority, using the Table 2 below, confirming that it represents the overall level of risk to the organisation, given the current controls.

Priorities	Likelihood				
Impact	**A**	**B**	**C**	**D**	**E**
A	Very High Risk	Very High Risk	High Risk	High Risk	Medium Risk
B	High Risk	High Risk	Medium Risk	Medium Risk	Low Risk
C	High Risk	Medium Risk	Medium Risk	Low Risk	Low Risk
D	Medium Risk	Low Risk	Low Risk	Low Risk	Very Low Risk
E	Low Risk	Low Risk	Very Low Risk	Very Low Risk	Very Low Risk

Table 2. Risk Priority

The outcome of this stage is an initial analysis recorded as mapping of the significance of the identified risks. It is recognised that, particularly with simple scoring schemes, risks can be honestly assigned too high or too low a significance on the first pass (AusIndustry, 2001). The next stage is designed to review this assignment and adjust it where necessary.

2.4 Risk Assessment

The assessment stage takes the results from the preliminary analysis, and reviews risks against each other. At this stage, risks are considered in the context of the organisation's strategic business priorities. Any risks that have been accorded too high or too low a rating are adjusted, with a record of the fact being retained for tracking purposes.

As an extension of the assessment process, the inherent risk level for each risk can be considered. The inherent level of risk is the level that would exist if the controls did not work as intended. This provides and indication of the importance of the existing controls and a pointer to those areas where monitoring of controls may be important. The three-point scale in the table below is used as a guide.

Inherent Risk	
A	Major inherent risk
B	Medium inherent risk
C	Minor inherent risk

Table 3. Inherent Risk

2.5 Risk Treatment

Risk treatment consists of determining what will be done in response to the risk assessment. Any plans in place before the current risk management iteration began are revisited, and as appropriate are augmented with measures to treat the risks before they

can arise. Contingency plans are developed at this stage. They will be invoked to recover if a risk event actually occurs. In effect, once a risk event has occurred, the aim is to minimise the consequences.

In addition to these supplementary plans, treatment might also include alteration of related plans of the organisation. Occasionally the best way to treat a risk might be to adopt an alternative strategy, to avoid a risk or make the organisation less vulnerable to its consequences.

The responsible managers should complete Risk Action Plan Summaries for each risk classified as Very High or High on the agreed risk priority scale (Broadleaf Capital International, 1999).

- For Very High, High and Medium risks, a detailed Risk Action Plan is required, with a one-page executive Risk Action Plan Summary in the form shown. Similar risks, or risks for which a common treatment is indicated, can be grouped. All the boxes in the summary are required to be completed. For Medium risks, the Summary may be sufficient in many circumstances, but additional detail can be included if required. The summary can refer to existing work plans. Managers should amend existing work plans appropriately.
- For Low and Very Low risks, responsible managers should take into account the identified risks, and ensure they are covered by existing plans and procedures.

For risks that have an inherent risk level of Major, a summary should also be completed, focussing on the processes for enhancing and monitoring the effectiveness of the controls (AusIndustry, 2001).

Likelihood reduction is directed to eliminating sources of risk or substantially reducing the likelihood of their occurrence. **Risk avoidance** is a particular case of likelihood reduction, where undesired events are avoided by undertaking a different course of action. Examples include:

- The selection of alternative approaches,
- Procedural changes,
- Quality assurance procedures,
- Operational reviews,
- Regular audits
- Training and skills enhancement,
- Contract terms.

Impact mitigation is directed to minimising the consequences of risks. Some risks, such as those associated with economic variations, cannot be avoided, and although risk reduction may reduce the likelihood of them arising they may still occur. Risk management must then be directed to coping with their impacts. Impact reduction strategies include:

- Contingency planning,
- Quality assurance,
- Contract terms and conditions,

- Regular audits and checks to detect compliance or information security breaches,
- Crisis management and recovery plans.

Risk transfer shifts responsibility for a risk to another party, who ultimately bears the consequences if the risk arises. **Contracts** are the primary means of allocating risk between the parties involved in many business activities. Risk assessment, in identifying how risks might arise, can provide the initial guide to which party is best able to manage the risks. However, transferring risk to a contractor or another Department (e.g. the Australian Taxation Office) may not really eliminate the risk, just transform it into a 'contractor failure' risk. **Insurance** is a well-known risk transfer strategy, but not of particular use in this situation. It is normally used for physical assets and a limited range of commercial risks, particularly for the low probability but high impact residual risks that may remain after other risk treatment actions have been implemented. Transferring a risk to another party will usually incur a cost, for example an insurance premium. Risk transfer is sometimes called **risk sharing**, because risks are rarely transferred or shed entirely (AusIndustry, 2002).

Risk acceptance occurs when risks cannot be avoided or transferred, or the costs of doing so would be high. The organisation must then accept the risks. Nevertheless, risk prevention and impact mitigation measures and monitoring are recommended.

The likelihood and impact ratings are used to determine the risk priorities, using priority ratings, as shown at Table 3. The table 3 also provides a guide to the kinds of risk treatment responses that may be relevant for each risk.

Treatment options:

Likelihood \ Impact	A	B	C	D	E
A	A –Major			B – Problem	
B					
C					
D	C – Catastrophe			D – Routine	
E					

Table 3. Risk Priorities Rating

- **Major risk area**. Detailed risk treatment action is required. This may be directed to reducing the likelihood of the risk (or avoiding it altogether), or to reducing its impacts, or both. In the table, this has the effect of moving the residual risk to the regions labelled B, C or D.
- **Problem area**. Risks in this area have high likelihoods, but moderate to low impact. Treatment actions can often be directed to improving management systems and procedures. This area typically receives a lot of management attention because of the high frequency and may result in an over allocation of resources.
- **Catastrophe area**. Risks in this area have low likelihoods but potentially high impact. Effective preparation and crisis management or contingency plans are often valuable options for the catastrophic residual risk. Management should ensure that this area receives the appropriate resources even though it seems less urgent.
- **Routine area**. Risks in this area can often be managed by standard routines, systems and procedures, or on an *ad hoc* basis.

3. Managing Risk on a Continuing Basis

Monitoring and review link risk management to other management processes. Continuous monitoring and review of risks in the organisation is an important part of implementation. It ensures new risks are detected and managed, and that action plans are implemented and driven forward effectively (AusIndustry, 2001). Initially, the watch list will contain all the risks classified as Very High and High, with selected Medium risks. As risk issues are resolved or change, or as new risks arise, the Watch List will be updated.

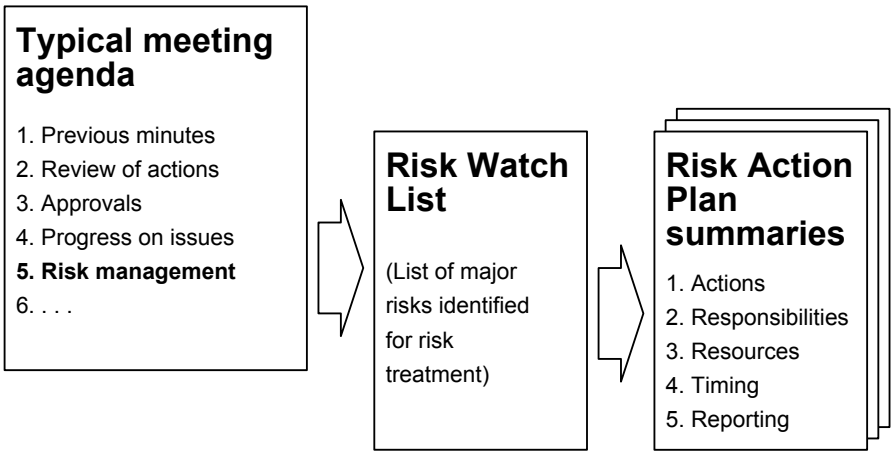

Figure 2. Watch List

Under the heading Risk Management in the meeting agenda, several items will be considered.

- For each risk on the Watch List, the progress and effectiveness of risk treatment actions will be reviewed, and adjustments to Risk Action Plans will be made as needed.
- Very High, High and Medium risks for which effective risk treatment has been completed will be removed from the Watch List.
- Medium or Low risks that have changed in status and become important enough to be re-classified as High or Very High will be included in the Watch List, and responsibilities and timing for preparing detailed Risk Action Plans will be allocated.
- Any new identified risks will be considered, and Very High and High ones will be included in the Watch List. For each new risk included in this way, the responsibility and timing for preparing a detailed Risk Action Plan will be allocated. Risk Action Plan Summaries for all new Very High, High and Medium risks will be included in the Risk Register and Risk Action Plans attached to the Risk Assessment and Management Plan.
- Trends and general issues in programme risks and risk management will be considered, and any necessary changes to risk management strategies will be made.

The nature of the risks will change as the programmes and implementation timeframes change. Regular reviews of risks and risk treatment will be undertaken as part of the normal management process to revise the lists of Very High and High risks, to generate new Risk Action Plans and to revise the Risk Watch List (Broadleaf Capital International, 1999a).

4. Case Study

The key goal for the R&D Tax Concession program (AusIndustry, 2002) is:

"to encourage Australian industry to undertake more systematic research and development activities".

The R&D Tax Concession is the principal Commonwealth Government incentive to improve and increase the level of private sector funded R&D being conducted in Australia. It is broad-based, market-driven and supports much of the industry R&D spending in Australia. Through the R&D Tax Concession, the Government aims to achieve its broader objective of developing efficient and internationally competitive Australian industries by (AusIndustry, 2001):

- increasing private sector investment in R&D;
- encouraging better use of Australia's research infrastructure;
- improving conditions for the commercialisation of new product and process technologies developed by Australian companies; and
- developing a greater capacity for the adoption of foreign technology.

The Australia and New Zealand Standards call for the documentation of an organisation's policy for risk management, including objectives for, and its commitment to, risk management. The risk management policy for the R&D Tax Concession is (AusIndustry, 2001):

"To minimise events which may adversely affect the encouragement of Australian industry undertaking more systematic R&D activities by minimising the likelihood and effect of risks which may adversely affect the efficient and effective provision of advice, information and delivery of the R&D Tax Concession program administered by AusIndustry."

The likelihood and impact of a risk 'problem' occurring will determine the level of action required to address the risk. Political, economic, social and accountability factors may all have an effect on the steps taken to mitigate the risk of an event occurring. The return from engaging resources (be they personnel, time or monetary) to mitigate a risk may be insufficient beyond a point to warrant further effort. For example, a moderate risk with negligible economic consequences will receive less attention than a low risk with high political consequences.
The table 4 and 5 below summarise the likelihood and impact measuring scale for this strategy, and is used when assessing each risk.

Likelihood	**Indicative level of occurrence**
Almost certain	Is expected to occur in most circumstances
Likely	Will probably occur in most circumstances
Moderate	Will occur at some time
Unlikely	Could infrequently occur
Rare	May occur only in exceptional circumstances

Table 4. Likelihood of the Risk Management

Consequence	Indicative level of consequence
Catastrophic	Closure of program, huge financial loss, non-achievement of all program objectives
Major	Major financial loss, non-achievement of most program objectives
Moderate	Medium financial loss, non-achievement of some program objectives
Minor	Low financial loss, some impact on program objectives
Insignificant	No financial loss, minimal impact on program objectives

Table 5. Consequence and Indicative Level of Consequence

Combining these two factors, a rough indicator of overall risk level can be determined, as Table 6, below:

Likelihood	Consequence				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Moderate	High	High	Extreme	Extreme
Likely	Low	Mode rate	High	Extreme	Extreme
Moderate	Low	Low	Moderate	High	High
Unlikely	Low	Low	Low	Moderate	High
Rare	Low	Low	Low	Low	Moderate

Table 6. Likelihood and Consequence

Extreme risk: Immediate action required
High risk: Senior management attention needed
Moderate risk: Management responsibility must be specified
Low risk: Manage by routine procedures

Each key element of the Tax Concession as administered by AusIndustry needs to be identified (ie. 'the context'), then the related process and the risk inherent in each process/element (ie. 'identify risk') determined. The overall risk, or priority, of each risk should then be evaluated (ie. 'analyse/evaluate risk') and the controls required to mitigate this risk identified. There are a number of approaches to treat identified risk, including reducing the likelihood of occurrence, reducing the consequence of occurrence, transferring the risk (in part or full) to another entity or taking steps to avoid the risk altogether (Hunter and Smith, 2002).

A breakdown of the key elements of AusIndustry, the associated risks, their likelihood and consequence and the current controls in place to reduce or remove these risk is contained in the following pages under the 'Risk register' (and is based on the Australian Risk Management Standard). After taking into account all of the preceding factors, the priority of the risk must then be determined.

This priority rating is included as the last column in the 'Risk Register' table. Prioritising each risk then provides a basis for determining which risks to address first. For example, where a risk, after current controls, is determined to be High, this risk should receive more immediate attention than a risk, which (with current controls) is low. Whilst low risks should not necessarily be ignored, resources should be first applied to higher priority risks (Broadleaf Capital International, 1999b).

The 'Risk treatment schedule and plan' (which follows the Risk Register and is also based on the Australian Risk Management Standard) aims to provide a list of the risks from the Risk Register, their priority rating with current controls in place, and the additional actions required to decrease each particular risk to an acceptable level. If remedial action is required, the schedule should also be completed to include a summary of the person responsible for taking the action and an indicative timeline.

The Australian Standard, in addition to a Risk Register and Risk Treatment Schedule and Plan, also recommends using a 'Risk Action Plan' template which effectively summarises in one page the identified risk, the further action required and the responsibility and timing for the action. A Risk Action Plan template, based on the standard, follows the Risk Treatment Schedule and may be useful as a summary for the person tasked with implementing a required action. So that this strategy remains up to date, a template has also been provided to enable staff to provide feedback where they consider a unidentified risk, or the controls associated with an identified risk, to be unacceptable (Knight, 2001).

This Risk Management Framework is well established but the systemic dimensions seem to have been lost. This approach has uni-directional rather than causal relationship. In other words, the systemic inter-relationship within and between steps, incorporating both lead and lag indicators which impact on organisational performance is not included. In this sense, System Dynamics can facilitate the surfacing and analysis of causal relationships and feedback structures, which are essential to the success of the Risk Management Strategy (Hillson, 2001).

5. Critics from System Dynamics Perspective

5.1 What is System Dynamics?

Forrester (1961) defined System Dynamics as *the investigation of the information-feedback characteristics of systems and the use of models for the design of improved organizational form and guiding policy.* Coyle (1979) defined it as *a method of analyzing problems in which time is an important factor, and which involve the study of how the system can be defended against, or made to benefit from, the shocks which fall upon it from the outside world.* In addition, Wolstenholme (1990) defined it that *a rigorous method for qualitative description, exploration and analysis of complex systems in terms of their processes, information, organizational boundaries and strategies; which facilitates quantitative simulation modeling and analysis for the design of system structure and behaviour.* According to Sterman (2000), System Dynamics is *a method to enhance learning in complex systems. It is a method for developing management flight simulators, often computer simulation models, to help us learn about dynamic complexity, understand the sources of policy resistance, and design more effective policies.*

Combining elements of these viewpoints, system dynamics may be defined as *a methodology for understanding complex problems where there is dynamic behaviour (quantities changing over time) and where feedback impacts significantly on system behaviour* (Linard and Paterson, 1995). It provides a framework and rules for qualitative description, exploration and analysis of systems in terms of their processes, information, boundaries and strategies, facilitating quantitative simulation modeling and

analysis for the design of system structure and control. In a nutshell, System Dynamics is the rigorous study of organizational problems, from a holistic or system perspective, using the principles of feedback, dynamics and simulation[4]. There are roughly seven stages in approaching a problem from the system dynamics perspective (Richardson, 1999):

1. problem identification and definition,
2. system conceptualisation,
3. model formulation,
4. analysis of model behaviour,
5. model evaluation,
6. policy analysis,
7. model use or implementation.

The process begins and ends with understandings of a system and its problems, so it forms a loop, not a linear progression. Figure 3. shows these stages and the likely progression through them, together with some arrows that represent the cycling, iterative nature of the process. At a number of stages along the way one's understanding of the system and the problem are enhanced by the modelling process, and that increased understanding further aids the modelling effort (Richardson and Pugh, 1981).

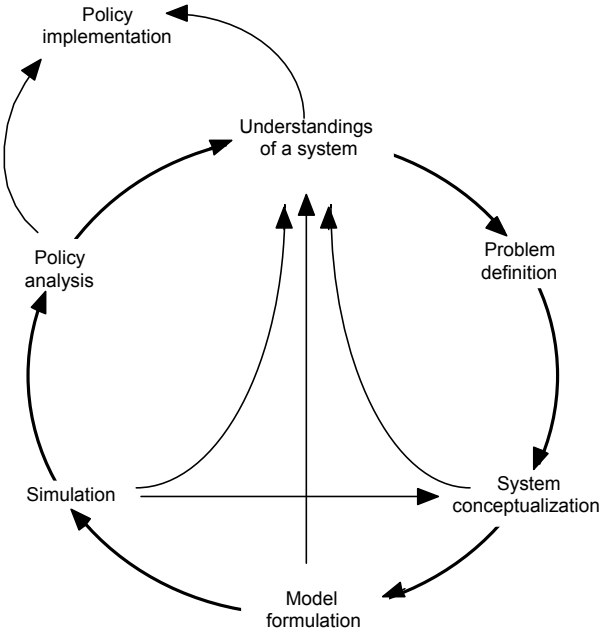

Figure 3. Overview of the System Dynamics modelling approach (Richardson, 2000)

In system dynamics, systems are seen as composed of a number of interlinked feedback loops. Many relationships between variables in social systems are non-linear. The combination of feedback loops with delays and non-linear relationships gives rise to a wide variety of behavioural characteristics of systems. It is the combination of feedback

[4] Using simulations, companies can test out tactical decisions and experiment with marketing or product-development strategies. The purpose of simulations is to help people understanding the basics of business, and in particular the financial implications of various decisions (Harvard Management Update, June 2000).

with delays and non-linearity that can produce unexpected or counterintuitive model behaviour.

The event-oriented worldview leads to an event-oriented approach to problem solving, Figure 4. shows how we often try to solve problems. We assess the state of affairs and compare it to our goals. The gap between the state we desire and the state we perceive, defines our problem.

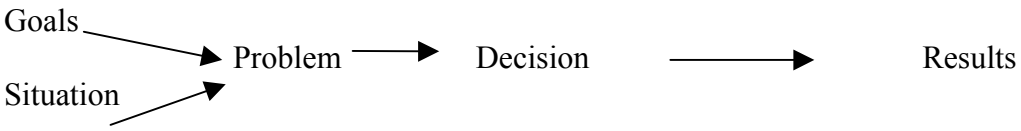

Figure 4. Event-Oriented View of the World (Sterman, 2000)

Thinking is largely linear-causal, that is, for each cause there is only one effect, and that effect changes linearly with changes in the cause. Such assumptions underlie traditional approaches to risk management. Whilst it is possible for managers to develop detailed understandings of cause and effect by cycling repeatedly and quickly through the process described in AS/NZS 4360, building a 'feel' for systemic reactions to their management strategies depends on experience. Unfortunately, learning from experience is exceedingly difficult when the system reacts to the solution, and yesterday's solution becomes today's problem.

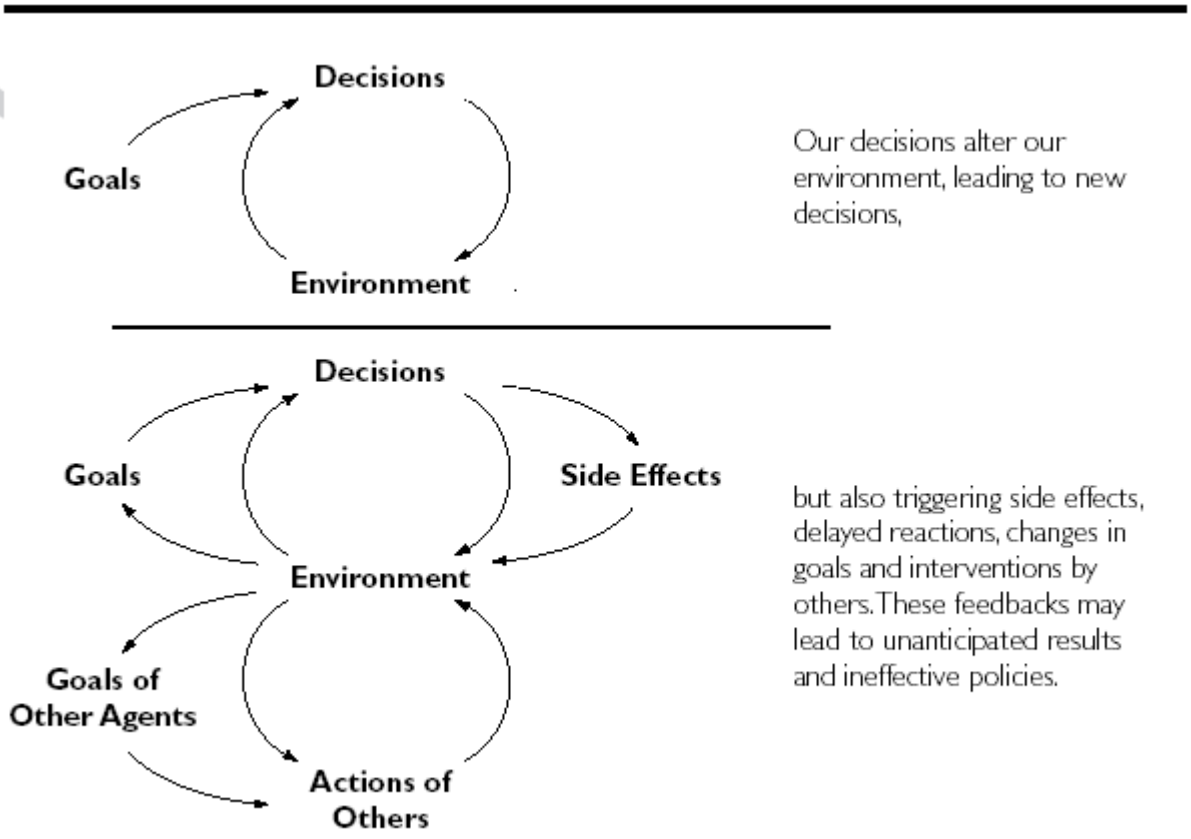

Figure 5. The Feedback View (Sterman, 2000)

Sterman (2000) stresses that an in-depth understanding of feedback mechanisms is essential, and learning from real-world experience is inefficient and can be costly. Further, our attempts at managing can be confounded by the results of our earlier attempts at remedial action. Earlier actions will define the situation we face in the future. The new situation alters our assessment of the problem and the decision we take tomorrow. Figure 5. depicts a feedback view, and suggests why we need to take an approach to risk management which involves feedback (dynamic, systemic) thinking.

Even well intended efforts to solve pressing problems often lead to policy resistance, where the policies are delayed, diluted, or defeated by the unforeseen reactions of other people or of nature. Many times our best efforts to solve a problem actually make it worse (Sterman, 2000). McLucas (2000a, 2000b, 2000c, 2001: 64-123) found that when managers were unable, unwilling, or ill-equipped to develop systemic views of evolving problems, the results were failures to understand what was developing around them. In turn, this led to repeated failures in the management of risks.

The human mind is ill suited to derive the dynamic consequences of complex feedback systems. Hence the need for simulation as an analytical solution of the model is needed. In this sense, computer simulation is central to the system dynamics discipline. Until 1987 the key software tool available (Dynamo, a Fortan like language) required skilled programmers and was difficult for line managers to use without significant support. System dynamics enhance learning in complex system. This inhibited acceptance of the methodology.

Powerful graphical software is now available for Macintosh and PC. This allows the modellers, working closely to managers, to construct visual and symbolic representations of the complex, dynamic problems.

Models of complex problems require complex mathematics. Models of problems involving change over time and feedback require the solving of multiple differential equations. This new generation of graphically oriented software automatically generates the structure of the 'nth order' differential equations necessary for solving complex feedback problems, cutting development time dramatically and reducing the likelihood of errors. Mathematical knowledge is still critical in fleshing out the interrelationships between parameters, and it is still possible to build erroneous equations (Linard, 1997).

Particularly in group settings, qualitative and quantitative system dynamics modelling tools and techniques can be used in combination to facilitate the development, and detailed analysis, of dynamic hypotheses about cause and effect. In a risk management context, system dynamics modelling offers unprecedented opportunities for analysing quite complex causality, such as multiple cause and effect mechanisms and delayed effects.

The promised outcome of adopting a system dynamics approach is that with the aid of systems thinking and system dynamics modelling, managers should be able to build better understandings of the underlying mechanisms conspiring to produce what they recognize as manifestations of risk. Managers also now have the opportunity to see how risks develop, rather than observing them 'after the fact'. 'After the fact' learning is learning

from *bitter* experience because such learning is expensive, but does not necessarily involve in-depth understandings of systemic causality. The modelling challenge remains, that is, to develop in risk managers the necessary understanding and situational awareness [5] leading to 'before the fact' development of highly effective risk management strategies. Whilst a solution, through systems thinking and system dynamics modelling, seems to be available why is it not being embraced in the public sector just as AS/NZS 4360 has been?

5.2 Critics on Risk Management Strategy from System Dynamics perspective

Measuring the effect of an action related to new and complex activities is particularly problematic since it is difficult or impossible to establish risk measures for activities with which the organisation has no or very little experience. Also the relationship between measures in current risk management framework is ambiguously described.

The cause-and-effect relationship may also be criticised on the basis of a neo-classical economic analysis. The relationship between identifying the risk and assessing the risk is a logical one and not a cause-and-effect relationship. Therefore, it is uni-directional and cannot include delay and feedback In other words, it can be indicated that the steps are interdependent because the influence between measures is not unidirectional. The reasoning is circular, so instead of a cause-and-effect relationship, the relationship between areas is more likely to be one of interdependence.

An assumption of causality should play a dominant role and relationships among steps being assumed to be unidirectional must be changed. Giving up the assumption that cause-and-effect relationships are involved has major consequences for the efficiency and validity. Finality is fundamentally different from cause-and-effect relationship (Mattessich, 1995). If the risk management framework is assuming finality instead of causality, it is no different from many other old approaches. The power of the instrument to make statements and to serve the purposes of management control will be greatly reduced (Norreklit, 2000).

In conclusion, the risk management strategy aims to contribute to reducing the problems involved in using only limited measures for the purposes of control. It inserts logic measurements in a strategic framework so that they are not merely loosely coupled local systems, but linked together in a chain, which passes through the entire company. However, the framework has problems with some of its key assumption and implementation such as uni-directional, ignorance of delay and feedback. In addition, it has a problem in causal relationship.

In this sense, system dynamics modelling approach can be introduced for efficient risk management strategy because system dynamics modelling is based on causal analysis. One of the major advantages of system dynamics modelling is that it combines the strength of the human mind and the power of computers to tackle complex, dynamic problems.

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[5] Decision-makers are drawn to certain situational cues and not to others because of their situation awareness. This pattern matching process happens all the time, and these responses to the environment are automatic. Situation awareness is one basis for what we call 'intuition': recognising things without knowing how we do the recognising (Klein, 1998: 33). Klein's claim is that situation awareness grows out of experience.

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