A REVIEW OF RISK IN DEFENCE EQUIPMENT SELECTION

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Discussion Paper 01/99

Abstract

This paper offers some glimpses into the rationale behind defence equipment selection. Policy level analysis identifies the general capabilities required and the consequent equipment characteristics required. Risks and penalties associated with these equipment selection decisions at this level are explored, and opportunities to moderate them are identified.

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1999

ISBN 0-475-20105-1

Introduction

The Defence Force is expected to provide the nation with a range of capabilities. In the modern world, these capabilities are generated by people, training, and equipment. Personnel selection methods are comparatively easy to change, and training depends on equipment in use. Thus equipment is essentially the driver of available capability. Consequently, the Defence acquisition process starts with Capability Planning, when required capabilities are identified and consequent equipment characteristics established. It is then possible to look to the market place for the specific equipment that will provide best value for money.

This paper examines risk management options available to capability planners involved in Defence major capital equipment selection. It classifies risk in the Defence Planning context, explores potential moderation opportunities and identifies some that are impractical. It also examines elements that affect risk management such as risk likelihood and its estimation, risk penalties and moderation costs. It provides a review rather than nostrums.

From a management perspective, there is little point in considering risk if there is no opportunity for its moderation (including avoidance). There is thus a tacit linking of risk and capacity to moderate it.

Process and Terminology

This section clarifies some of the terminology and concepts. The equipment selection and acquisition process is summarised, and defence policy, capability planning, and aspects of risk are briefly enlarged.

Equipment Lifecycle

For new equipment to enter service, it must be assessed as appropriate for New Zealand Defence Forces needs. Needs follow from government policy on Defence. Once a class of equipment is approved, the acquisition process obtains a specific equipment from the market place. The equipment is then put into operational use until the end of its life. Periodically it may be evaluated for its suitability and effectiveness of use.

Ministry of Defence

The New Zealand Ministry of Defence is responsible for Defence policy. Two of its functions are Capability Planning, and Equipment Acquisition. The Ministry provides advice on general parameters within which the Defence Forces must operate. This includes employment contexts for military application, and associated equipment needs.

Capability Planning

In consultation with other areas, Capability Planning section in the Ministry of Defence provides advice on employment contexts for application of military force, and the associated general equipment needs. It examines ways in which the New Zealand Defence Forces might be used in support of Government policies and objectives, the characteristics of military capabilities, and the selection of specific types and quantities of equipment. It does not directly include equipment financing, acquisition, or evaluation.

Aspects of Risk

Features associated with risk include its nature and how it might be moderated. Its nature is an assessment of the likelihood of an event or circumstance, and the penalty associated with it. Assessments of both may change with time. To moderate risk requires opportunities, associated timing, and methods. Moderating a risk may invoke costs. Often there are events leading up to a circumstance, which may themselves have risks and moderation opportunities.

Risk Classes and Moderation Opportunities

The purpose of this section is to itemise potential risks and their consequences (penalties), as well as opportunities for reducing their likelihood or penalty (moderating the risk). Some apparent moderation opportunities are not practical. Consequently, the whole range is listed (Tables 1-3), some drawbacks identified, and a more reduced list presented (Tables 4-6).

From a policy perspective, the principal areas for risk moderation are Policy, Acquisition and Operational. Policy opportunities lie in goal setting and equipment selection. That is, identifying Government expectations of the Defence Forces, and the consequent needs for equipment (types and numbers). In Acquisition, many policy equipment decisions are implemented and details finalised. Few risk moderation opportunities impact on policy. In the Operational area, opportunities important to policy arise at the time of any decision to become involved in a military action. Some potential opportunities are illustrated later in Tables 1-3.

Table 1
Risks, Moderation Opportunities, and Penalties – Policy Area

	Risk	Possible Penalties	Moderation Opportunities
1.	The equipment will not allow policy objectives to be met (in general), without undue risk. For example through inadequate self-defence, interoperability with allies, or fire-power.	Government objectives not met. Equipment lost. Lives lost. Poor value for money. Undesirable limits on operations with allies.	Policy definitions and expectations. Moderation strategies built in to policy. Equipment selection. FFBNW. Equipment upgrade policy. Increase funding. Delay, or spread acquisition over a longer period.
2.	An instance of a policy objective will occur, that cannot be met without undue risk.	Government objectives not met. Equipment lost. Lives lost. Increased costs. Poor value for money. Decreased budget funding.	Indeterminate. Sometimes none, or a result of political and diplomatic negotiation, or equipment selection. Equipment acquired at the last minute.
3.	Policy objectives will change, and the equipment will be unable to support the new objectives.	Government objectives not met. Equipment lost. Lives lost. Increased costs. Poor value for money. Undesirable limits on operations with allies.	Indeterminate. Includes political/ diplomatic negotiation. Moderation strategies. Equipment selection. Fit - FFBNW Equipment upgrade policy. Equipment acquired later or at the last minute.
4.	Threat and warning times worsen.	Government objectives not met. Equipment lost. Lives lost. Increased costs. Poor value for money.	Moderation strategies. Equipment selection. FFBNW Equipment upgrade policy. Equipment acquired later or at the last minute.

Table 2
Risks, Moderation Opportunities, and Penalties – Acquisition Area

	Risk	Possible Penalties	Moderation Opportunities
5.	Numbers required will not be obtainable, for reasons of price or changing specifications etc.	Government objectives not met. Equipment lost. Lives lost. Cost. Poor value for money. Cancellation of acquisition.	Increase funding. Revisit policy area, looking for a decrease in policy aims allowing a lower cost option. Delay, or spread acquisition over a longer period. FFBNW.
6.	Costs increase beyond the foreseen – examples include additional components being required, and exchange rate variations.	Government objectives not met. Equipment lost. Lives lost. Increased costs. Poor value for money. Cancellation of acquisition.	Increase funding. Delay, or spread acquisition over a longer period. Manage contracting better.

Table 3
Risks, Moderation Opportunities, and Penalties – Operational Area

	Risk	Possible Penalties	Moderation Opportunities
7.	More lives or equipment will be lost than is reasonable in meeting a policy objective.	Government objectives not met. Equipment and/or lives lost.	At the time of commitment to the task: equipment augmentation, ally support, last minute acquisition.
8.	Equipment will not be available and operable when required, and for the amount of time required.	Government objectives not wholly met. Reduced long term capacity. Cost. Poor value for money.	Decrease time spent on other activities – eg training, last minute acquisition. Decline to meet policy goal.
9.	Personnel required will not be available or will not have the correct type or degree of training.	Reduced equipment functionality, possibly leading to mission failure, loss of lives etc. Increased cost.	Increase time on training. Obtain training from elsewhere eg commercially in NZ, overseas. Decline to meet policy goal.
10.	Normal peacetime attrition is more than allowed for, and the number of equipment units is inadequate.	Government objectives not wholly met. Reduced long term capacity. Increased cost. Poor value for money.	Decrease time spent on other activities – eg training. Look for a policy change. Decline to meet policy goal. Acquire additional equipment.

There are a number of types of risk relating to military equipment, its acquisition, and use. Some are assessable in a quantitative sense, but many are not. With the passing of management opportunities to moderate risk, choices decrease, while potential penalties remain unchanged. Tables 1-3 identify the principal areas of risk, associated penalties, and theoretical opportunities for moderation. The acronym FFBNW is used for Fitted For But Not With. It implies that a major unit of equipment (usually a platform) is acquired with the capacity to install lesser equipment, such as weapons or sensors, at a much later date. This may be when there is a perceived need for its application.

Discussion

A number of moderation opportunities in the tables can be eliminated. Some are not realistic for reasons of cost or effectiveness, some are too hard to include in the planning, and some are essentially generalised restatements. There are also opportunities that may change the nature of the problem, but do not deal with it. These elements are discussed below.

An important feature of acquisitions is "fixed cost". It is a cost associated with each project that does not depend directly on the number of items to be acquired. It is incurred by both providers and consumers. Elements contributing to fixed costs include: determination of exact needs, acquiring facilities specific to the equipment, initial training, and some components of normal overheads. Equipment providers pass on fixed costs, albeit buried in the unit price. Discounts for quantity reflect this reality. Depending on the equipment and its application, total fixed costs of both provider and consumer can be very high – sometimes many times the incremental cost of a single unit of equipment.

Policy Elements and Expectations

Although Government expectations can be changed with a new agreement between Government and New Zealand Defence Forces, this is rare. It is only likely to follow from significant alterations to the Defence environment. They might follow changes in Government philosophy, national circumstances, world circumstances, or military equipment and operations.

Similarly, total funding is not easily changed and is primarily in the political arena. If it is fixed, another option might be a spending re-balance within the Defence budget. However, balances between personnel, maintenance and logistics, and capital expenditure are largely a function of past decisions, and the scope to change them in the short run is minimal. By reviewing equipment's through-life costs, some changes can be made, but the rate of change must be slow when equipment is acquired with lifetimes in decades. The balance between environments (Land, Sea, Air) has similar problems, and is constrained by the need to provide the widest capacity for response to unforeseen circumstances.

Moderation strategies built in to policy can only employ methodologies identified elsewhere in the table, such as upgrade policies and acquisition strategies.

Fitted-For-But-Not-With (FFBNW)

The opportunity to add equipment to a platform at the last minute (FFBNW) sounds attractive, but the concept has some important drawbacks:

(a) New military equipment is rarely available at the notice available to meet an identified contingency. Competing demands from other Nations involved in the contingency can also impact on availability.

(b) Technical developments often occur between original platform acquisition and FFBNW equipment acquisition time. They can cause serious integration difficulties that are expensive and time consuming to overcome. Examples particularly include the protocols used to ask for and supply information electronically.

(c) Training required to use new equipment to full effect is often time consuming. For example, without opportunities for personnel to operate with the equipment, they will not develop an understanding of the way the equipment can be used, or of its limitations and vulnerabilities.

(d) Cost may be much higher than if the equipment had been obtained initially. There may be many reasons for this. For example, the manufacturer may recognise the urgency of the requirement and will be able to drive a harder bargain. There may be less competition because the FFBNW process is likely to focus on a specific equipment. There will also be additional fixed costs.

For these reasons, FFBNW is not often seen as an effective strategy in the long run. Nevertheless, it is currently practised, and can be a way of overcoming short term funding problems. Where equipment is highly modularised, fairly autonomous, and easy to integrate, many of the drawbacks may not appear for some considerable time after the primary acquisition.

Delay Acquisition or Spread Over a Longer Period

This approach appears to offer access to more funding. In practice it has a number of side effects:

(a) It is likely to impact on the funding available for other equally important but later demands.

(b) It requires that existing equipment be operated for a longer period. This may cause problems due to reliability, availability of spares and the need to make special purchases, obsolescence of equipment relative to threat or demand for facilities.

(c) Potential for decreasing similarity of units as they come from the production line. Manufacturers commonly change the build standards of equipment with time. This happens because operating experience provides learning about equipment failure modes, and because changes in contributing components can offer more capability or less cost. This is not normally a problem for short acquisition spreads, but will increase with the length of the spread. Dissimilarities in major units can cause serious training and maintenance problems

There are times when this approach is not possible, including opportunity buys (often of second hand equipment), and equipment that has some New Zealand specific elements with a particular build standard. Nevertheless, this approach might be a practical one in some instances.

Delayed Acquisition of Part of the Long Term Requirement

Major equipment acquired at a later date may also sound attractive. The need for new equipment in this context may arise from attrition, changes in threat, changes in policy, and equipment degradation. However, such demands for additional equipment commonly occur in small numbers. Principal drawbacks are identified below.

(a) Each new acquisition incurs fixed costs, both from the provider and the consumer.

(b) The scope for competition is reduced due to the need to operate with existing equipment.

(c) Equipment often has a life that depends on usage (e.g. operating hours). Units acquired well into the life of existing equipment are unlikely to be close to their end-of-life when the older equipment needs to be replaced. Thus their residual life is likely to be lost.

(d) As with FFBNW, delayed acquisitions will also be subject to delays in delivery, and mismatching with older equipment due to technical advances.

(e) Thus, acquiring all equipment under one contract involves a single fixed cost, and allows units to be aged at similar rates. All-of-life fixed costs are thus minimised, and because no units have abnormally low total usage, overall life-of-type is extended without additional cost.

Political And Diplomatic Negotiation

Sometimes situations will arise that cannot be met without undue risk or haste. At these times, Defence might hope that political and diplomatic negotiation might alter the situation, by producing delays or enlisting other forms of support. Such factors are case specific, and apart from providing breadth of capacity in equipment selection, there is little that planners can do to take advantage of such opportunities.

Reduced Range Of Opportunities

Eliminating opportunities with serious drawbacks identified in the above discussion, leads to Tables 4-6.

Table 4
Risks, Moderation Opportunities, and Penalties – Policy Area

Risk		Possible Penalties	Moderation Opportunities
1.	The equipment will not allow policy objectives to be met (in general), without undue risk. For example through inadequate self-defence, interoperability with allies, or fire-power.	Government objectives not met. Equipment lost. Lives lost. Poor value for money. Undesirable limits on operations with allies.	Equipment selection. Equipment upgrade policy. Delay acquisition, or spread over a longer period.
2.	An instance of a policy objective will occur, that cannot be met without undue risk.	Government objectives not met. Equipment lost. Lives lost. Cost. Poor value for money. Decreased budget funding.	Equipment selection.
3.	Policy objectives will change, and the equipment will be unable to support the new objectives.	Government objectives not met. Equipment lost. Lives lost. Cost. Poor value for money. Undesirable limits on operations with allies.	Equipment selection. Equipment upgrade policy. Delay acquisition, or spread over a longer period.
4.	Threat and warning times worsen.	Government objectives not met. Equipment lost. Lives lost. Cost. Poor value for money.	Equipment selection. Equipment upgrade policy. Delay acquisition, or spread over a longer period.

Table 5
Risks, Moderation Opportunities, and Penalties – Acquisition Area

Risk		Possible Penalties	Moderation Opportunities
5.	Numbers required will not be obtainable, for reasons of price or changing specifications etc.	Government objectives not met. Equipment lost. Lives lost. Cost. Poor value for money. Cancellation of acquisition.	Delay acquisition, or spread over a longer period.
6.	Costs increase beyond the foreseen – examples include additional components being required, and exchange rate variations.	Government objectives not met. Equipment lost. Lives lost. Increased costs. Poor value for money. Cancellation of acquisition.	Delay acquisition, or spread over a longer period. Manage contracting better.

Table 6
Risks, Moderation Opportunities, and Penalties – Operational Area

Risk		Possible Penalties	Moderation Opportunities
7.	More lives or equipment will be lost than is reasonable in meeting a policy objective.	Government objectives not met. Equipment and/or lives lost.	At the time of commitment to the task: ally support.
8.	Equipment will not be available and operable when required, and for the amount of time required.	Government objectives not met. Reduced long term capacity. Cost. Poor value for money.	Decrease time spent on other activities – eg training.
9.	Personnel required will not be available or will not have the correct type or degree of training.	Reduced equipment functionality, possibly leading to mission failure, loss of lives etc. Increased cost.	Increase time on training. Obtain training from elsewhere eg commercially in NZ, overseas. Decline to meet Policy goal.
10	Normal peacetime attrition is more than expected, and the number of equipment units is inadequate.	Government objectives not met. Reduced long term capacity. Increased cost. Poor value for money.	Decrease time spent on other activities – eg training. Decline to meet Policy goal. Acquire additional equipment.

Assessing Risk Likelihood

The purpose of this section is to identify the different approaches to risk assessment that are in common use. Examples are used as the primary explanation vehicle.

Risk likelihood can only be assessed from the information available at the time and can change with time in unforeseen ways. Risk assessment does not necessarily imply quantification. It can be a relative ranking, or a decision as to whether the risk is "reasonable" or not. Quantification implies a measure such as the probability of an event. Assessments based on opinion are intrinsically open to

question. However, when a range of suitably qualified individuals or groups produce similar results, the assessment is likely to be as good as is achievable at the time.

Three examples follow to illuminate assessment methods.

(a) A quantification example. Estimate the likelihood that there will be sufficient aircraft remaining at the end of the life of type, assuming peacetime operations. Such an assessment would be based on an operational requirement for a certain number of aircraft, a flying rate per year (for training, practice, and to retain skills) and an average loss rate per flying hour. Planners may assess the probability of loss for a range of aircraft numbers, and decision makers then can choose a level of risk that is "reasonable". For instance, planners may estimate aircraft attrition probabilities to be 57% for 4 losses, 21% for 6 losses, and 5% for 8 losses. Thus if decision-makers want to be 95% sure of an adequate fleet at the end of its life, 8 attrition aircraft are needed. This is a quantified assessment.

(b) A ranking example. Estimate the likelihood that there will be a war in SE Asia in the next 25 years. Answers might be remote, low, medium, high, or certain. Different people will produce different assessments, and may use different methodologies to reach their conclusions. However, provided that there is a general consensus around a level, the assessment is probably as good as is practically achievable. Decision-makers might then compare assessments across a number of areas, and assign resources according to relative priority.

(c) A risk prediction example. Estimate the need for equipment in an incompletely defined circumstance, such as providing convoy escort in a Balkans peacekeeping scenario. The result might be in very broad terms, such as armoured vehicle with high mobility and protection against larger calibre small arms, but possibly protection against a canon. The assessment is not a clear articulation implying consequences, so much as an implicit prediction of what is "reasonable" and the associated requirement.

Risk Penalties and Moderation Costs

The purpose of this section is to eliminate the repetition of penalties and moderation opportunities in Tables 4-6, and to expand on their causes and consequences.

Common penalties are financial, equipment lost, lives lost, battles lost, increased risk elsewhere, and opportunities foregone. Common moderation costs are financial, reduced opportunities, and increased reliance on allies with consequent loss of control or profile.

Penalties and Causes

Based on Tables 4-6, the penalties listed in Table 7 could arise. Associated with each penalty are possible causes and possible consequences.

Table 7
Penalties, Causes, and Consequences

Penalty	Cause	Possible Consequence
Government objective not met, or incompletely net.	Unavailability or inadequacy in a primary element (platform, mobility, weapon etc.,). Risk of loss of life or resource unacceptable.	Lost opportunity for NZ representation or profile. Weaker ally. Weaker bargaining position. Government embarrassment.
Reduced long term capacity. The consequences of this penalty could manifest in any of the other penalties.		
Reduced equipment functionality, possibly leading to mission failure, loss of lives etc.	Unavailability or inadequacy in primary element (mobility, weapon etc.,).	Lost opportunity for NZ representation or profile. Weaker ally. Weaker bargaining position. Government embarrassment. Loss of lives, equipment, or full mission success.
Equipment lost.		
Lives lost.		
Increased cost, of either acquisition or operation or both.	Additional fixed costs, increased manufacturer profits, integration costs, training costs, cost of "workarounds".	Reduced funding available for other important acquisitions and operations.
Poor value for money.		
Undesirable limits on operations with allies.	Unavailability or inadequacy in a primary element (mobility, weapon etc.,).	Lost opportunity for NZ representation or profile. Weaker ally. Weaker bargaining position. Government embarrassment. Reduced range of cooperative activities and information exchange. Reduced respect.

One cause of some penalties is an inadequacy in any of the critical military elements that might be affected by acquisition decisions. Such elements include a complete platform, its protection and self defence, firepower, mobility, direct support, or logistics support. Other intelligence and information related elements could affect engagement decisions, battlefield intelligence, and training.

In the event of small and last minute acquisitions, urgency and fixed cost issues will make the cost per unit much higher than normal. In the event of equipment inadequacies, the capacity to do the job will be reduced, and either the job will not be attempted, the attempt will fail, or the success will come after a longer period or greater losses.

Moderation

Reducing risk likelihood or risk penalty may cost money or result in opportunities foregone. Acquiring more equipment or more comprehensive fittings lifts the cost of acquisition. Limiting the circumstances in which the equipment might be used could result in opportunities foregone at some indeterminate future time. Planning to upgrade equipment later, so that lower costs can be incurred in the short run, is likely to cost money in the long run, although it is also a mechanism for keeping up with changes in technology and military practice. The likelihood of opportunities foregone should also be lower because of the improved predictability of shorter run eventualities.

Table 8

Moderation Opportunity Costs

Opportunity	Cost	Possible Cost Consequence
Delay acquisition, or spread over a longer period.	Reduced capability for some period.	Increased risk of a short-term inadequacy (see penalties).
--	Reduced finance or slippage elsewhere.	Inappropriate re-balance of investment.
Equipment selection.	Higher cost. Other.	Reduced finance available for some other project.
Equipment upgrade policy.	More planning. More fixed costs.	--
Manage contracting better.	--	--
Acquire additional equipment.	Higher cost.	Reduced finance available for some other project.
At the time of commitment to the task: ally support.	Political cost.	Reduced political status.
Decline to meet Policy goal.		
Decrease time spent on other activities – eg training.	Long term availability of suitable personnel.	Finance to provide additional training at a later time or in another place.
Increase time on training. Obtain training from elsewhere eg commercially - NZ, overseas.	Cost.	Reduced operating funds.

One of the opportunities is equipment selection. This is a non-trivial task, with many inputs, including assessments of future threats and areas of military involvement, reviews of available equipment, and identification of the policy goals to be satisfied. They all change with time and circumstances. Improvements in such inputs will impact on equipment selection risks.

Moderating Risk

To moderate risk, event probability may be reduced or event penalty may be reduced (or both), or circumstances leading to the event may be avoided.

From a Defence policy perspective, there are two different types of undesirable event: conflict events, and capability events. Conflict events are those in which there is some military presence, and capability events are those in which capability is reduced to below adequate operational levels, through peacetime attrition losses, or relative capability loss by technological advances for example.

Conflict Event Probability

To reduce conflict event probability in a policy context, there are few options. Political negotiations and measures at the time of the event are not in the policy domain. Such events with "excessive" penalties, are only controllable (in the context) by eliminating them from the list of those agreed with government.

Having the capacity to inflict damage may be sufficient to reduce conflict probability. However, apart from maximising combat capacity in general, there is little that can be done at the planning stage. This opportunity is more likely to be affected by readiness, effectiveness, and alliances.

Capability Event Probability

To reduce capability event probability in a policy context, there are a number of options. They include acquiring additional equipment for attrition, through-life upgrade plans to reinstate relative capability, and equipment acquisition and replacement planning to avoid block obsolescence.

Conflict Event Penalty

To reduce the potential penalty of a conflict event, there are very few options:

(a) Invest more resources in the general facilities available. That is, increase generally available firepower, protection, mobility, intelligence, and force effectiveness (through training, organisation, and resource selection).

(b) Invest more resources in the event itself. That is, increase capability locally to provide more superiority.

(c) Invest fewer resources in the event itself. That is, decrease the potential for loss.

Clearly (b) and (c) are in opposition, and the conditions of application are different. In the case of (c), any increased risk of failure must be balanced against the decreased potential for losses.

Capability Event Penalty

To reduce the potential penalty of a capability event requires active future planning and possibly more resource investment at certain critical times. For example, planning for attrition replacements may require investment at the time of acquisition so as to avoid unnecessary fixed costs and integration problems. Similarly, planning for upgrades near the time of acquisition could allow longer-term threats and problems to be dealt with as a series of short-term problems.

Conclusion

At the policy level, there are few opportunities available for moderating risk. In the main they require additional expenditure, planning, or more effective equipment selection and contracting. It is not appropriate to speculate how these moderations might be made, beyond the elements already identified.