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The effects of organisational decision making on supply chain execution.

A case study of the NZDF Light Armoured Vehicles
Supply Chain

Submitted in partial fulfilment of the requirements for a Master of Supply Chain Management thesis

99261110 SHEREE ALEXANDER

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Glossary

Accountability		The assurance that an individual or an organisation will be evaluated on their performance of the task, function, or activity assigned, and rewarded or disciplined based on the evaluation. (Bovens, 2007) (accountability, 2018)
ABC		Activity Based Costing
Agile or agility		“The ability to rapidly and cost effectively adapt to market changes with no significant negative impact on quality or dependability.” (CSCMP, 2013)
Authority		The right or power assigned in order to achieve the task, function or activity. This includes the right or power to change procedures if necessary to achieve the task, function, or activity. (Certo & Certo, 2009)
Combat Service Support		“The support provided to combat forces, primarily in the fields of Administration and Logistics.” (Australian Army, 2009)
CI		Continuous Improvement
CLM		Council of Logistics Management
CSS		Combat Service Support
DTP		Defence Transformation Programme
Effective		Maximising the achievement of outputs (Fugate, Mentzer, & Stank, 2010) (Anon, How to ensure effectiveness and efficiency in productivity, 2018)
Efficiency		Maximising the use of available resources to meet demands – cost to the organisation is often the key factor. (Fugate, Mentzer, & Stank, 2010) (Anon, 2018)
Empowerment		“Empowerment is based on the idea that giving employees skills, resources, authority, opportunity, motivation, as well as holding them responsible and accountable for outcomes of their actions will contribute to their competence and satisfaction.” (Anon, 2017)
Enterprise Resource Planning System		“A class of software for planning and managing “enterprise-wide” the resources needed to take customer orders, ships them, account for them and replenish all needed goods according to customer orders and forecasts.” (CSCMP, 2013)
FLOC 35		Future Land Operating Concept 2035
GSCF		Global Supply Chain Forum
HADR		Humanitarian Assistance and Disaster Relief
HQJFNZ		Headquarters Joint Forces New Zealand
JIT		Just in Time
Lean		“A business management philosophy that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination.” (CSCMP, 2013)
Logistics		Military logistics has been described as “all the activities and methods connected with the supply of armed force organizations,

including storage requirements, transport and distribution” (Luttwak, 1971). The Council of Logistics Management (CLM) revised their definition of Logistics in 1998 to “Logistics is that part of the supply chain process that plans, implements, and controls the efficient flow and storage of goods, services, and related information from the point-of-origin to the point of consumption in order to meet customers’ requirements” (Lambert & Cooper, 2000)

Materiel	“All items necessary for the equipment, maintenance, operation and support of Military Activities without distinction as to their application for administrative or combat purposes.” (New Zealand Defence Force, 2014)
NGO	Non-Governmental Organisation
NZDF	New Zealand Defence Force
NZLAV	New Zealand Light Armoured Vehicles
OGA	Other Government Agency
Responsibility	The obligation to perform a task, function, or activity assigned to an appropriate standard. (Bivins, 2006)
SAP	Systems, Applications, and Products
Supply Chain Management (SCM)	The Global Supply Chain Forum (GSCF) defined SCM as “the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders” (Lambert & Cooper, 2000).
TOC	Theory of Constraints
VfM	Value for Money
1 st – 4 th Line	“1 st Line – Unit resources under the control of the unit commander. E.g. The logistics company of an infantry battalion. 2 nd Line – Resources and activities under the control of a formation commander... E.g. A logistics battalion of a brigade. 3 rd Line – Support provided to a force by CSS elements that are not organic to the formation or unit. E.g. A force support battalion or National Support Element. 4 th Line – Logistics resources and activities provided by a base logistics battalion, Original Equipment Manufacturer, or National Support Base.” (Logistics Operations School, 2012)

1.0 Introduction

1.1 Research objective and questions

The purpose of this research is to examine how organisational management models, outside of traditional corporate supply chains, drive supply chain success. Corporate supply chains have applied supply chain improvement theories and practices, which have resulted in supply chain success and, ultimately, organisational success. Supply chains for military industries and non-commercial industries are not sufficiently unique to be able to discount the advances that have occurred in corporate supply chain management (SCM) concepts. This lack of uniqueness has seen the military industry commence implementing supply chain improvement theories and practices to its supply chains. Limited research has been conducted into the rationale for non-commercial industries delaying the implementation of advances in SCM concepts or, when they have been implement, why they have not had the desired level of success. Research in the field of organisational management and its influence on supply chains may provide insight into how advances in SCM concepts can be successfully transferred from commercial organisations to other industries. The New Zealand Defence Force (NZDF) provides a non-commercial context with sufficient complexity regarding its drivers for implementing changes that are likely to result in observable performance trade-offs with respects to SCM and organisational management models.

This research will examine existing and previous supply chain and organisational management scenarios to determine the level of success achieved. It will also identify strengths and weaknesses with the existing models and propose an alternative organisational management model. This research will answer the following questions:

Question 1: What influences success for supply chains of organisations employing traditional hierarchical management structures?

Question 2: How does the organisation's environment and management structure shape supply chain design?

Question 3: What supply chain decisions or responsibilities should be allocated to the strategic, tactical, and operational management levels?

Question 4: How should a hierarchical organisational management model be adapted to improve supply chain performance?

1.2 Background

For civilian organisations a supply chain failure can result in lost sales, for the military it can result in battlefield failure and cost lives. This view of the uniqueness of military operations is held by

several key individuals and has resulted in limited or delayed changes to military SCM. Rutner et al (2012) concluded that updating the United States (US) military supply chain is irrelevant so long as their military remains ahead of its opponents. Van Creveld (2004) argued that in war combat power is the determining factor of supporting troops – if 100 support soldiers are needed to ensure one combat soldier is sustained then 100:1 is the optimum ratio. Lieutenant General Pagonis (1992), the US General responsible for implementing the logistics plan for Operation Desert Storm, said that efficiencies need to be sacrificed to maintain a higher margin of safety on the premise that military operations are unique. Success on the battlefield is more important than having an efficient and cost effective military supply chain, or at least some believe it should be. Success on the battlefield, for emergency services saving lives, for humanitarian aid workers delivering aid after a disaster should not be constrained by cost efficiencies, but this implies an infinite supply of resources. What happens when the US military can no longer increase its defence budget in order to remain ahead of its opponents? Every humanitarian dollar spent on administration is a dollar not spent on actual aid for the population in need. Resources are not limitless and for, most organisations funding, is a constraining factor.

The view of organisational uniqueness and the subsequent rationale for not applying improvement theories is not constrained to the military. The very nature of humanitarian assistance creates a supply chain that is often unstable – driven at one end by an activity and its participants, and at the other by wishes or whims of political and private donations (Oloruntoba & Gray, 2006). By its own measures humanitarian supply chains are also unique – supply chain failure here is not about lost sales, but a failure to provide the basic necessities of life to a population after a humanitarian disaster. The supply chain for medical items is subjected to varied consumption rates due to disease fluctuations, the requirement for temperature control measures throughout the chain, and expiry dates. In the medical supply field producing too much of one item could potentially be an unsustainable overspend for a company; holding insufficient inventory and not being able to transport items to meet the customers demand could also have a significant negative effect on a company. Technology is constantly being superseded, therefore a technology based supply chain must manage inventory levels and types (completed assemblies or parts), the speed of information (customer's demand to the suppliers producing the item), and rapid movement of required items throughout the chain all to meet the customer's expectation levels (Dell being the prime example). Highly fashionable products create unpredictability for their supply chains (Christopher & Towill, 2000) – it is not always possible to know what will be in fashion or when, therefore such supply chains must be incredibly responsive if they are to

capitalise on the market. Each of the supply chains described are unique in their own way, but they have a number of similarities.

Lambert, Cooper and Pagh (1998) Supply Chain Network Structure illustration (Figure 1) can be used to demonstrate each of these seemingly “unique” supply chains; the focal company could easily be a military organisation, a humanitarian aid agency, a pharmaceuticals company, or a fashion label.

Figure 1: Illustration of a Supply Chain Network Structure
(Lambert, Cooper, & Pagh, 1998)

In the commercial business context the driving factor for improving supply chains is financially motivated – whether that is through reducing costs within the chain, retaining customers by improving satisfaction levels, improving dividends to stakeholders’ year on year. Van Wassenhove (2006) showed that humanitarian organisations were forced to review their supply chains because donors providing funding were demanding transparency; money needs to be going towards the population in need rather than organisation administration costs.

The New Zealand Defence Force (NZDF) has been driven to change its SCM in spite of no changes in its mission (New Zealand Defence Force, 2010, 2011, 2012, 2013, 2014, 2015) (New Zealand Defence Force, 2014) (New Zealand Government, 2016). There have been increases in deployment tempo and variety; long missions to Afghanistan and Sinai, peace keeping in Solomon Islands and East Timor/Timor Leste, anti-piracy missions and patrolling of NZ Exclusive Economic Zone (EEZ), ongoing support to Antarctica, responses to natural disasters in NZ and overseas, and

multiple search and rescue missions (New Zealand Defence Force, 2010, 2011, 2012, 2013, 2014, 2015) (New Zealand Defence Force, 2014) (New Zealand Government, 2016).

Like the commercial business context military organisations are being driven to make financially motivated changes. The NZDF with the Value for Money (VfM) review, the Defence Transformation Programme (DTP) and subsequent changes in organisational structure plus capability modernisation have all been designed to “free up resources through the creation of leaner and smarter support services” (New Zealand Defence Force, 2011). The purpose of these improvements was to ensure that the NZDF “remains affordable and is as efficient and effective as possible in delivering military capabilities” (New Zealand Defence Force, 2015). The US Military were also grasping with the changes necessary to reduce costs whilst remaining effective organisations in the late 1990s (Reimer, 1999) (Wilson, Coburn, & Brown, 1999). This saw the US Military look to the Just in Time (JIT) philosophy to replace the previously used Just in Case philosophy to improve efficiencies with some success but potential for further improvements (Wallis, 2008) (Heseltine, Jr, Winter 2007/2008). One review of the US military supply chain changes stated that “Uncertainty, disorder, and fluidity will continue to characterize battlefields, and logistics must adapt accordingly” (Stevenson, 2011). This was echoed in the NZ Defence White Paper 2016 that highlighted the rapidly evolving strategic environment in which the NZDF operates (New Zealand Government, 2016), this will drive flexibility to be an essential criteria of the supply chain.

Before launching into further research on SCM and the impact of commercial business supply chain theories on militaries it is pertinent to consider a few definitions and how they are applied to the NZDF. Military logistics has been described as “all the activities and methods connected with the supply of armed force organizations, including storage requirements, transport and distribution” (Luttwak, 1971). This description of logistics is reflected in Australian Defence Force and NZDF doctrine (Australian Army, 2009) (Logistics Operations School, 2012). The Council of Logistics Management (CLM) revised their definition of Logistics in 1998 to “Logistics is that part of the supply chain process that plans, implements, and controls the efficient flow and storage of goods, services, and related information from the point-of-origin to the point of consumption in order to meet customers’ requirements” (Lambert & Cooper, 2000). Both definitions would suggest that logistics is a function constrained to within one organisation. As demonstrated by Figure 2 below, logistics would occur within each of the separate manufacturing areas. Logistics also occurs between the separate manufacturing areas in the form of distribution and warehousing; more often this is being referred to as integrated logistics.

Figure 2: Activities and firms in a supply chain.

(New & Payne, 1995)

It is difficult to obtain a consensus on the definition of logistics and it is considerably more challenging to define the concept of SCM. Keah Choon Tan provided a model (Figure 3 below) to classify SCM literature and summarised the corporate vision and intended business results.

Figure 3: A framework for supply chain management literature.

(Tan, 2001)

The perspectives within the literature might differ but the vision and intended business results outlined by Tan are similar. This would indicate that there is some scope for consensus on a definition of SCM. The Global Supply Chain Forum (GSCF) defined SCM as “the integration of key

business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders” (Lambert & Cooper, 2000). This definition is broad, it does not exclude or include organisations based on product or services they deliver or the functions completed within the organisation. One key point however is the implication that SCM crosses multiple organisations; as few, if any, organisations these days are self-reliant for the manufacturing of the raw material through to the consumption of the finished product. The GSCF definition of SCM would seem to be an apt definition for many non-commercial supply chains (the NZDF included), though it should be acknowledged that the depth or maturity of SCM may vary across organisations.

Whilst there might be consensus that SCM is a “cross-disciplinary concept” (Mentzer, Stank, & Esper, 2008) there is discussion regarding which management level (strategic, tactical, or operational¹) is responsible for SCM decisions (Lambert, Cooper, & Pagh, 1998) (Stank, Davis, & Fugate, 2005). Mentzer, Stank, & Esper (2008) discuss the negative implications of one functional area or level assuming responsibility for SCM decisions and that, as the SCM “phenomenon” impacts on virtually all areas of an organisation, no one area or level should assume all responsibility for such decisions. If collating all SCM decisions into one functional area or within one management level of an organisation is not conducive to generating success, then how should the decisions be distributed? Although the military context (as with other non-commercial industries) is not so unique that supply chain improvement theories can be discarded, the organisational management model employed at the business or industry level may shape the level of supply chain success possible from such theories.

1.4 Research Topic

Militaries and humanitarian organisations may have been slow to pick up on the vocabulary or the need for improving their supply chains but they are now considering or implementing the commercial business concepts for SCM. If the supply chain theories such as ‘Lean’ and ‘Agile’ are accepted as valid or proven means of improving SCM within an organisation, then it becomes necessary to identify and analyse why success is not always forthcoming for organisations that apply these theories. The limited success of such theories in the military context is often explained by the uniqueness of the environment, however military supply chains are not individually unique, at least not so much so that they can afford to discard the theories designed to improve supply

¹ Commercial supply chain terminology differs to military terminology – commercial supply chains refer to Strategic, Tactical and then Operational level of supply chain; the operational level includes the operators are on the shop floor. In military terminology the tactical and operational levels are switched around; the tactical level is where the operators are stationed. This thesis uses commercial terminology throughout.

chains. One factor that may be impeding the potential for performance improvement is the influence hierarchical organisational management models employed by militaries have on supply chain success. It is this area that needs further research in order to gain buy in with the supply chain theories such as 'Lean' and 'Agile' and ultimately improve effectiveness and efficiency of these apparently 'unique' organisations.

1.5 Potential Contribution to Knowledge

This research contributes to the limited pool of formal knowledge on non-commercial industries implementing SCM improvement strategies. It provides an opportunity to examine the influence of organisational management models on supply chain performance, in particular the challenges of achieving operational success from strategic level changes.

1.6 Research Method

This research will utilise the NZDF's Light Armoured Vehicle (NZLAV)² supply chain as a case study, commencing with a review of the strategic direction provided by NZ Government and NZDF Headquarters that drives the NZLAV supply chain design. This research includes a quantitative analysis of supply chain data, stored on NZDF enterprise application software programme, and qualitative analysis of supply chain views through an organisational survey. It concludes with an analysis of the organisation management model to determine what revisions are necessary to ensure ongoing supply chain success.

1.7 Content and Flow of remaining Chapters

This chapter has highlighted that the supply chain differences initially apparent between organisations do not create sufficiently unique exceptions that can justify the discarding of the need for supply chain improvements. It has discussed the research objectives and core questions which centred on understanding the appropriateness of organisational management models within the context of improving SCM.

Chapter Two provides a detailed literature review. Areas reviewed include models developed to improve SCM, models for measuring performance improvements within SCM, organisational management levels as they are used in SCM, and strategic supply chain direction provided in NZDF documents. This chapter concludes by suggesting an existing model to describe the relationship between organisational management structure and SCM within a mixed strategy supply chain. It

² The abbreviation NZLAV is used to prevent any confusion with other Light Armoured Vehicle variants used by other countries.

also proposes an alternative model to generate greater organisational success when implementing SCM improvements.

Chapter Three discusses the research methodology that will guide this research from ontological perspectives through to sources of data to be collected. This section concludes by detailing how the data will be analysed, data validity and reliability, and finally ethical considerations as they pertain to this research.

Chapter Four details the data collected as part of this research: electronic equipment management data on NZLAV availability status and survey data. This chapter will analyse the research data before providing a critique of the research. Chapter Four will conclude by highlighting the major findings and insights of data analysis.

Chapter Five will provide a detailed discussion of the data in relation to the proposed research model before concluding by identifying areas of further research.

Chapter Six provides research conclusions and recommendations that should be considered by organisations who are implementing supply chain improvement models. This chapter will answer the research questions individually and details the original contribution to the topic area that this research provides.

2.0 Literature Review

2.1 Introduction

This research is informed by Forrester's (1958) conclusion that supply chains are not immune to the effects of system dynamics. The application in this research was not Forrester's conclusions as they pertained to a production line, but as a thought process. An organisation's supply chain cannot be considered an isolated function of the business; supply chain success is influenced by internal decisions and also external organisations decisions. One crucial aspect as identified by Frohlich and Westbrook (2001) was the need for a holistic approach to supply chain thinking – strategic level thinking about supply chain improvements must be cognisant of the impact external organisations have on one's own organisation. Supply chain improvements must also be cognisant of other areas internal to the organisation; a supply chain improvement that negatively affects the performance of another organisational area may not improve the overall organisational performance. Lambert et al (1998) supply chain integration model, the Just in Time (JIT) production model or lean thinking in Japan's Toyota firm, and agile supply chain models all provide a different thought process for supply chain improvement. These models have been adapted to show how specific environments can apply supply chain improvement models to their benefit. Christopher and Towill (2000) provide a strategic thought process for humanitarian organisations that demonstrates how lean and agile optimisation measures can be successfully combined to meet the uniqueness of such supply chains. Lee's (2002) Matched Strategies model that provides a strategic thought process that considers the impact of supply chain uncertainties, which could be applied to organisations, irrespective of their uniqueness.

The next aspect of the literature review considers how to measure performance changes resulting from supply chain improvement models applied to organisations. Beamon's Supply Chain Management System (Beamon B. M., 1999) is reviewed because it accounts for Forrester's system dynamic effects on supply chains. The first two literature review areas show that the research has tended to focus on SCM improvements across organisations and accounting for different supply chain environments. These provide the necessary background knowledge for the next area reviewed, which is regarding organisational management models used within SCM.

The third area of the literature review considers the application of organisational management levels within the military and commercial environments, specifically focusing on the division of responsibilities at each level within organisations. This area of the literature review will discuss the allocation of responsibilities and strict hierarchal division compared with an overlapping or more inclusive allocation of responsibilities.

The final area of the literature reviewed are those strategic NZDF documents that do or should influence NZDF supply chain management. This section will focus on identify the supply chain direction provided by each document and comment on the value provided to supply chain improvements. This chapter will conclude by discussing existing organisational management models and proposing an alternative research model.

2.2 Supply Chain Management Models

Previous research has concluded that companies needed to understand how system dynamics influenced the performance of their organisations (Forrester, 1958). The relationships between functional areas within an organisation and also between organisations are crucial as decisions made in one area or one organisation will have a wider effect; the flow of information throughout the system determined success. Organisations have acknowledged that improvements to its supply chain will enable it to remain competitive (Ragatz, Handfield, & Scannell, 1997); this is true for production and non-production based companies alike. A variety of improvement models have been proposed as a means of allowing organisations to remain competitive.

Frohlich and Westbrook (2001) discuss the supply chain improvements resulting from integration across companies but the extent to which business processes across companies within a single supply chain should be linked has not been confirmed; with Lambert et al (1998) arguing that companies actively choose not to fully integrate. Lambert et al (1998) concluded that supply chain management success is dependent on which to integrate with, what processes to integrate, and the level of integration necessary. The supply chain integration illustration shown in Figure 4 provides a model for considering the types, level and who is responsible for the integration. However this model only requires organisations to consider how integration fits in with their current processes or links; the model does not require them to reconsider if the processes or links should exist.

The JIT production model or lean thinking, which originated from Toyota's manufacturing model, aims to only produce what the customer demands just as it is demanded (Womack & Jones, 1996). In theory the JIT model eliminates waste from the supply chain – production of the final item is postponed until last safe moment and inventory holdings reduced which reduces warehousing costs, time not expensed producing items that are not required, strive for perfection in items reducing the number of defective items produced etc.

Figure 4: Supply Chain Integration Model
(Lambert, Cooper, & Pagh, 1998)

As highlighted by Stalk (1988) the JIT model has been successfully implemented by many companies. Cox (1999) outlines the eight characteristics that define successful lean companies; though he concludes the JIT model cannot be applied without understanding the strategic and operational position of the companies that have successfully implemented it. This would indicate that not all companies can successfully implement the JIT model. Christopher (2000) argues that a lean supply chain is most suited to a predictable demand environment, whereas an agile supply chain is most suited to an uncertain demand environment.

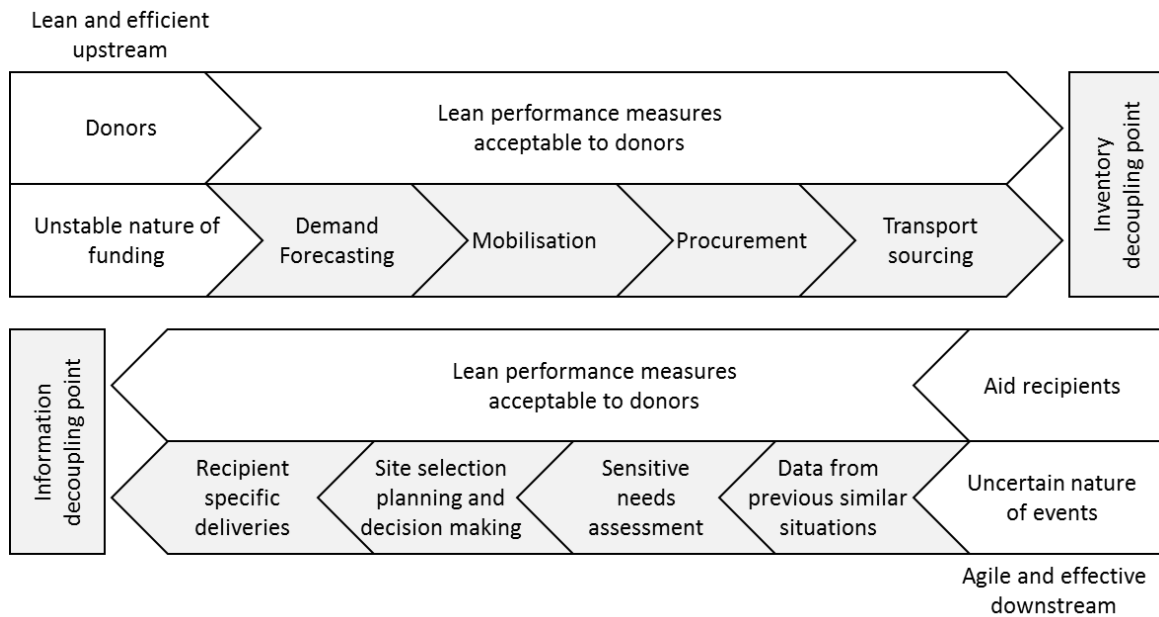
Some research has concluded that an agile supply chain is a strategic thinking model rather than a functional model employed at the tactical or operational level (Power, Sohal, & Rahman, 2001). This echoes Naylor et al (1999) concept whereby supply chain agility is about using knowledge to exploit opportunities in an uncertain environment. Agility is therefore about maximising the best of everything; using lean philosophies where there is certainty in the supply chain yet retaining sufficient safety to be appropriately responsive to changes in the environment and customer's needs. This is supported by Christopher and Towill (2001) who conclude that an integrated supply chain is necessary for successful supply chain design as the lean methodologies contribute to agility within the chain. Christopher and Towill's (2001) integrated model (Figure 5) for enabling agility within a supply chain is a thought process that could be applied by organisations at the strategic level.

Figure 5: An integrated model for enabling the agile supply chain
(Christopher & Towill, 2001)

Christopher and Towill (2000) proposed the following model (Figure 6) for an agile humanitarian aid supply chain. The model is not prescriptive; it does not specify a consistent geographic or system point at which the supply chain must change from lean and efficient to agile and effective. They use the term decoupling points to demonstrate that strategic inventory should be maintained in its generic form as far through the chain as possible, yet information needs to be readily available as far back through the chain as possible. The model at Figure 6 has potentially greater operational and tactical application than the integrated model (Figure 5) as it more clearly outlines which functions of the supply chain should be considered for lean versus agile.

This concept of decoupling points is supported by Naylor et al (1999) who also concluded that lean and agile supply chains need not exist in isolation; with their decoupling point being the location where stock is held as a buffer between lean (efficient) production and unknown demand (which requires agile response).

Figure 6: An agile supply chain for humanitarian aid
(Christopher & Towill, 2000)



Christopher and Towill's (2000) model provides a generic model for the humanitarian supply chain, but does not necessarily account for the differences in products within that supply chain. Fisher (1997) introduced the "uncertainty framework" as a means of determining the correct supply chain strategy for a product. Lee (2002) took this a step further and included "supply uncertainty". The conclusion from both Fisher (1997) and Lee (2002) is that companies should not try to fit one type of supply chain; instead they should match the strategy to the situation. Lee's (2002) Matched Strategies model is shown at Figure 7.

Figure 7: Matched Strategies
(Lee, 2002)

		Demand Uncertainty	
		Low (Functional Products)	High (Innovative Products)
Supply Uncertainty	Low (Stable Process)	Efficient Supply Chain	Responsive Supply Chain
	High (Evolving Process)	Risk-hedging Supply Chain	Agile Supply Chain

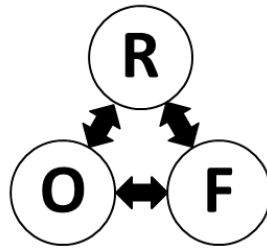
2.3 Supply Chain Performance Measures

It is not enough for organisations to select and implement a supply chain improvement model, they must be able to measure performance changes. There are a number of models for measuring supply chain performance; Activity based costing (ABC), benchmarking, balanced scorecard and Beamon's goals for supply chain performance. ABC systems account for how resources are expended for an activity (Pirttila & Hautaniemi, 1995). This allows for performance to be measured over time and what-if analysis can be conducted. For example the same activity conducted but the resources provided by different suppliers at different prices, will result in a different cost for the company. Although Pirttila and Hautaniemi (1995) steps for designing an ABC system are more complex than this simple scenario, it is difficult with ABC to attribute all costs to a specific activity.

Benchmarking is the measuring success based on comparing performance against another company; identifying industry best practices and then applying them to one's own organisation will result in improved performance (Camp, 1989). Fong et al (1998) outlines the various classifications and types of benchmarking; and Anand and Kodali (2008) provide a taxonomy of various benchmarking models. Aside from being resource intensive, one limitation of benchmarking as a performance measurement model is that it does not allow for environmental differences – comparisons would have to be between like organisations for best business practices to be applicable. Early benchmarking models failed to consider interactions between the points being measured within an organisation or the relationships between independent members involved in the same supply chain. Fisher (1997) and Gunasekaran et al (2001) and others have highlighted the challenge of developing a benchmarking model that can measure such interactions. The balanced scorecard or balanced metric framework may alleviate this lack of interaction by allowing the measurement of the same process from different points of view – customer, shareholder, supplier etc. Shepard and Günter (2006) summarise the criticisms of supply chain performance measurement systems: failure to connect with strategy, cost focused, unbalanced approach, internal assessment, and results of performance changes aimed at local optimisation.

Beamon's (1999) model (Figure 8) is an attempt at including all aspects of the supply chain, actively encourages assessment of interactions between supply chain characteristics, and recognises strategic goals. Beamon has identified three types of measures that contribute to overall supply chain success: Resources, desired outputs, and flexibility. Importantly, it is noted that any supply chain performance measurement system has to contain at least one individual measure from each type to be a valid assessment.

Figure 8: The supply chain measurement system
(Beamon B. M., 1999)



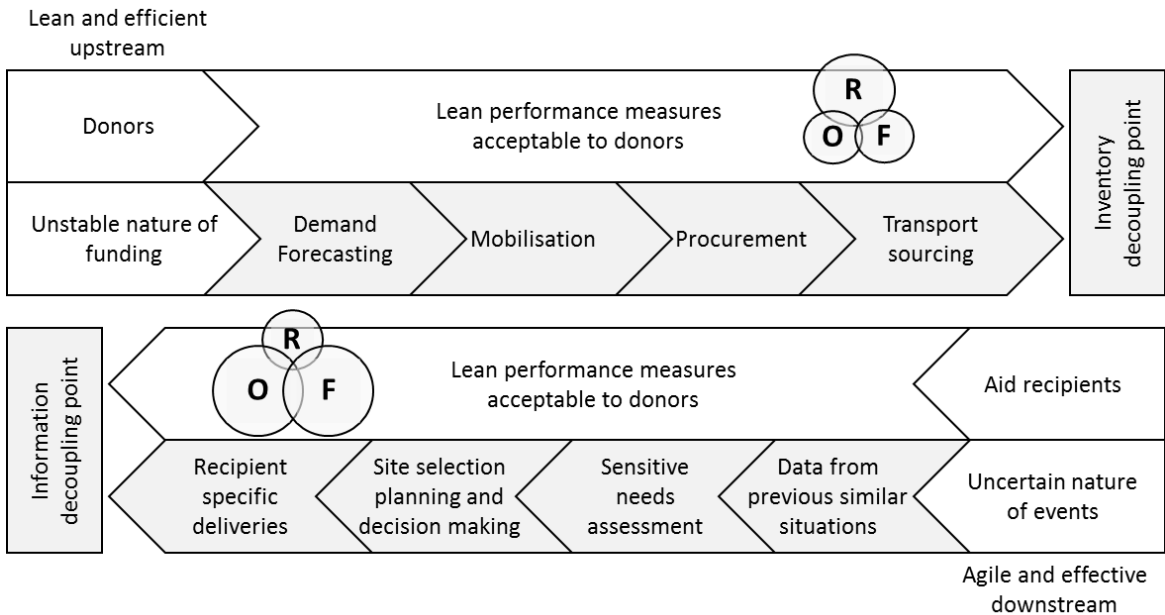
Performance measure type	Goal	Purpose
Resources	High level of efficiency	Efficient resource management is critical to profitability
Output	High level of customer service	Without acceptable output, customers will turn to other supply chains
Flexibility	Ability to respond to a changing environment	In an uncertain environment, supply chains must be able to respond to change

Although Beamon highlights that the organisation's strategic goals will drive the individual measures from each type, the model does not necessarily account for the supply chain environment or context. In some environments flexibility may be more desirable and therefore its measurements may necessitate a higher weighting than resources or outputs in order to accurately assess performance.

The advantage of Lee's (2002) model is that it accounts for changes in supply and demand uncertainty, thereby allowing organisations to change to match the supply chain environment or context. Christopher and Towill (2000) model balances the strategic level desire for efficiency with operational requirement for agility within the humanitarian context. Either of these two models, in theory, should allow a match between the strategic thought processes of optimisation and successful implementation of optimisation measures at the operational and tactical level. Therefore there is a need for a measurement model that factors in operational and tactical optimisation data to assess the strategic thought processes.

In a humanitarian context donors may want Beamon's model to be applied with equal emphasis on each measure, yet lean performance measures imply greater weight should be given to ensuring resource efficiency and the agility implies greater weight should be on outputs and flexibility. Overlaying Christopher and Towill's (2000) with an adaptation of Beamon's model could look like Figure 9.

Figure 9: Contextual performance model for assessing mixed strategy supply chains
(Christopher & Towill, 2000) (Beamon B. M., 1999)



In a military context (as with many other organisation types) with a variety of products in the supply chain falling into different categories of supply and demand uncertainty Lee's model can be used to guide the strategic thought process. Figure 10 overlays Lee's uncertainty model with Beamon's supply chain performance model producing an alternative contextual performance model that can be used to determine what supply chain strategy should be applied.

Figure 10: Adaptive Supply Chain Model
(Lee, 2002) (Beamon B. M., 1999) (Author, 2017)

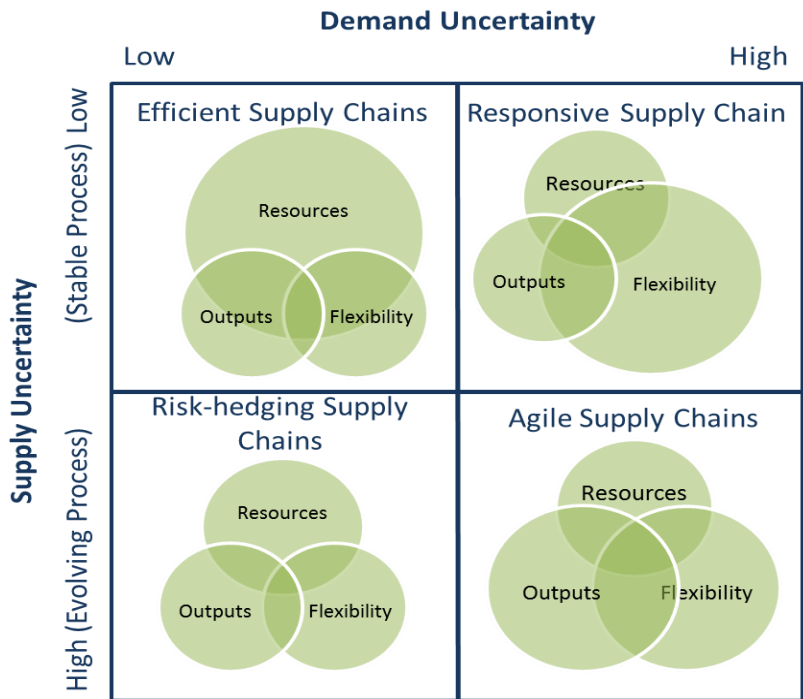


Figure 10 demonstrates that Beamon's measurements need to be weighted depending on the context. In efficient supply chains (low supply and demand uncertainty) the performance of resources is prioritised over outputs and flexibility. Maintaining a high level of customer service (outputs) and flexibility to respond to changes are still necessary performance criteria for an organisation; where uncertainty is low, these are not the central performance measurement criteria. The low uncertainty creates an environment where efficient resource management is the primary performance measurement for the organisation. In the case of a responsive supply chain, the high demand uncertainty creates an environment where organisations must be able to adapt to customers' changing needs. Flexibility will influence the organisation's performance more than resources or outputs. Agile supply chains are necessary where there is high supply and demand uncertainty; the environment created is one that needs high level of customer service (outputs) and high level of flexibility. Efficient use of resources, though relevant, is a lower priority when assessing the performance of an agile supply chain.

2.4 Organisational Management Models

Magee & Galinsky (2008) determined that despite attempts to reduce or remove hierarchy, it inevitably emerges between and within groups and organisations. They found that hierarchy is necessary for social interactions as it provides the necessary structure for groups and organisations to exist and flourish. This is supported by Bernstein, Bunch, Canner, & Lee (2016) who reviewed the Holacracy – a self-management organisational model. Even with a self-management model hierarchies exist; less rigid, less formalised, more temporary in their structure, but nevertheless interactions between personnel are shaped by hierarchical relationships. Holacracy has been tried and discounted by some organisations, which have reverting instead to a more traditional management model because self-management was difficult to coordinate as the company expanded in size or complexity (Bernstein et al, 2016).

Magee & Galinsky (2008) suggest that organisations with hierarchal structures will have a relative advantage over those employing less hierarchical structures. To a degree this is supported by the examples of companies adopting holacratic structures and then reverting to traditional management models in order to ensure organisational survival. Osborn & Hunt (2008) endeavoured to understand complex organisations who were seeking improved performance and what trade-offs were made to maximise performance. Research has shown, where the organisations' goal is to maximise performance, that environment should influence the management model employed (Bernstein et al, 2016) (Osborn & Hunt, 2008). Fast changing environments require organisational structures that allow for a high level of adaptability, but

where the appetite for risk is low then a structure that facilitates reliability is necessary (Bernstein et al, 2016). The relative advantage as highlighted by Magee & Galinsky (2008) does not reside with organisations that have hierarchal structures, but with those organisations that can shift their organisational structure as their environment shifts (Choi, Dooley, & Rungtusanatham, 2001).

Magee & Galinsky (2008) identified that once a hierarchal structure has been implemented it is difficult to modify. The fluid nature of personnel, whether through promotions, lateral shifts, departures, or changes in skills or knowledge, is not matched with the reallocation of responsibilities within an organisation. Instead Magee & Galinsky (2008) found that the hierarchal structure is rigidly reinforced by the transfer of responsibilities to the next incumbent of the position, regardless of appropriateness.

Magee & Galinsky (2008) conducted research into power and status and how these factors reinforced the inflexible nature of established hierarchies. Power, which is the property of the actor, is based on access to and control over resources (Magee & Galinsky, 2008). The potential amount of power held is determined by the role, but the actual amount determined by the value placed on it by the position holder; a senior manager has greater access to and control over resources than a lower level organisational member, but it is up to the senior manager to determine how powerful they actually are. Status, on the other hand, is conferred by co-actors or observers (Magee & Galinsky, 2008). Status is how others perceive your value to the organisation; individuals in a low status position will have less influence within an organisation. Within hierarchal organisations competence is often automatically attached to a position. This works in favour of those holding higher positions within the organisation; the status of the position confers greater (potentially) competence than is actually held for those in higher positions, however lesser competence for those in lower organisational positions. This is supported by Osborn and Hunt (2008) who found that those holding higher positions within the hierarchy held the belief that lower level organisational members were not sufficiently educated to participate effectively in significant organisational decisions.

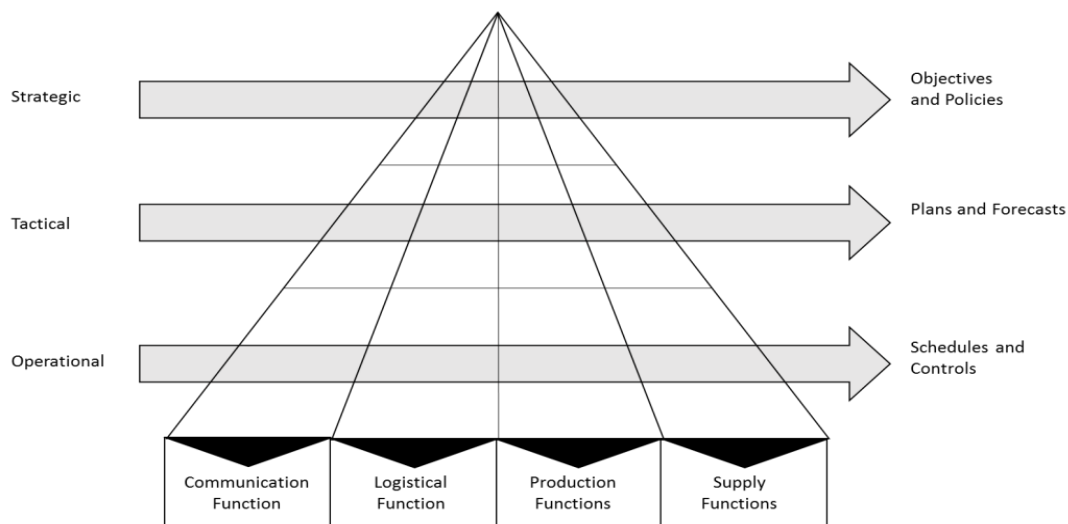
Magee & Galinsky (2008) also found that higher powered managers incorrectly appreciated or understood their subordinates' perspectives. Overbeck & Park (2006) determined that power holders, especially those influenced by efficiency performance measures, displayed a reduced ability to accurately identify unique characteristics of their subordinates. These factors of power and status can have a significant effect on an organisation's performance. Senior managers are often powerful individuals, with a greater level of competence attributed to them than may be

appropriate, and they can hold negative views of subordinates' ability to participate effectively in decisions or incorrectly appreciate subordinates' perspectives. This can result in proven theories or valid processes being forced on the organisation without due consideration being given to applicability of that theory or process within the specific environment (Osborn & Hunt, 2006). The best theory or process applied to the wrong organisation or applied wrongly within an organisation is unlikely to result in the desired level of performance improvement.

2.5 Organisational Management Levels within Supply Chain Management

Clausewitz discussed two levels of military operations; Gray (1999) included a third level (a middle level) in his discourse on modern military strategy. Clausewitz was writing 'On War' in the 1800s after the Napoleonic Wars, the distance between the soldier and strategic decision makers may not have been significant. Gray envisaged a greater distance geographically (and potentially in responsibilities) between the Generals and soldiers, this resulted in the need for a third level to maintain control. This three tiered structure is often reflected in the hierarchical structures of commercial organisations. One example of the traditional hierarchical structure is the model (Figure 11) used by Houlihan to show the relationship between the levels in respects to an effective international supply chain (Houlihan, 1985).

Figure 11: Levels of Management Control
(Houlihan, 1985)

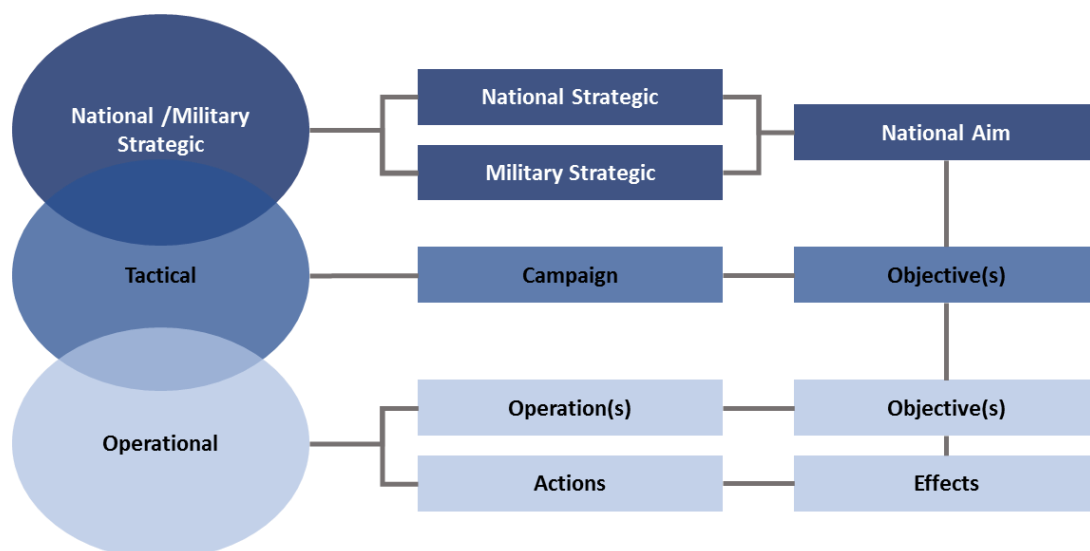


de Brito and Dekker (2002) outline a framework for explaining the differences between decisions made at each of the levels in respects to reverse logistics supply chain. Forward or reverse, domestic or international, the levels of management control within supply chain literature tend to include similar characteristics: Strategic – long term decisions, policy, network design, infrastructure, emerging trend or issues; Tactical – mid-term planning, procedure decisions, facility layouts, inventory levels, risks to current operations; Operational – executes

short term actions, controls achievement of directed tasks, risks to staff and daily procedures (Houlihan, 1985) (de Brito & Dekker, 2002) (Schmidt & Wilhelm, 2000) (Christopher & Peck, 2004) (Fox, Barbuceanu, & Teigen, 2000). As an example the strategic level would decide on the supply chain methodology for the company (e.g. Lean or Agile), the tactical level would decide on the inventory levels that matched the directed methodology, and the operational level is managing production in accordance with the available inventory and customer orders.

There are linkages between Clausewitz and Gray's views on the levels and how businesses apply them. Emerging businesses can have a closer relationship between the strategic decision makers and those at the operational level. As businesses grow it can become difficult for the strategic level to manage all supply chain matters that flow down to the operational level, creating a need for the tactical level. Figure 11 indicates a definitive line between each of the levels of management, implying that the authority and the knowledge to make a decision or take an action can only reside in one level. The military model (see Figure 12 below) is less definitive, instead showing that the levels will overlap to a certain, albeit unspecified amount. NZDF doctrine states that planning at all levels of the model is very closely linked, interdependent, and often occurs concurrently. Responsibilities and knowledge to make a decision invariably overlap and action taken at the lowest operational level may need to be responsive to strategic decision making, with the operational level outcome having immediate strategic significance (positive or negative). (New Zealand Defence Force, June 2012)

Figure 12: Levels of Military Operations adapted ³
(New Zealand Defence Force, June 2012)



³ To ensure consistency and clarity the labels of the levels in the military model have been adapted to reflect the commercial use of the tactical and operational terminology.

The descending hierarchical structure of the management model can imply a limited relationship exists between the three levels (Gray, 1999). Strategic success (in military or business) is reliant on success at the operational level as well as adapting strategy to match the shifting demands of politics (for military) and customers (for business) (Gray, 1999) (Hines, Holweg, & Rich, 2004). Muckstadt et al stated that strategic supply chain objectives set that are not achievable given the operational dynamics will result in decreased performance of the supply chain (Muckstadt, Murray, Rappold, & Collins, 2001). Lambert, Cooper and Pagh highlighted that organisational efficiencies, and subsequent financial savings, are possible in an integrated model rather than a strictly hierarchical (Lambert, Cooper, & Pagh, 1998). Other literature mimics this discourse on the need for supply chains to be designed with strong relationships between the three levels in order to move the organisation towards its goal (Lambert & Cooper, 2000) (Schmidt & Wilhelm, 2000) (Lee, 2002) (Fox, Barbuceanu, & Teigen, 2000) (Hutchin, 2002).

There is an agreeance in the existing supply chain literature of the need to link the levels of the management model and that the best supply chain strategy incorrectly applied will result in decreased performance. Fearn and Fowler stated that lean philosophies can result in supply chain improvements but incorrectly applied can result in reduced operational effectiveness (Fearne & Fowler, 2006). Their research was based on the construction industry and the ability to achieve projects on time given inventory constraints placed upon the operational level by the tactical and strategic level. Fearn and Fowler's conclusions are supported by other research, in particular research dealing with supply chain uncertainties. Christopher and Towill stated that lean concepts are appropriate in predictable supply chain environments; however agile concepts are more appropriate in volatile environments (Christopher & Towill, 2000). Therefore the ability to switch philosophies to respond to fluctuations in supply chain uncertainties becomes crucial to organisational success, yet the current management paradigm is not appropriate for decision making in an uncertain environment (Muckstadt, Murray, Rappold, & Collins, 2001).

Addressing the deficiency in the existing management paradigm will be essential for supply chain management users to move beyond the issues arising from uncertainties in the supply chain environment. As highlighted earlier the theories of lean six sigma, agile logistics, theory of constraints (TOC), and Continuous Improvement (CI) are valid theories or methods for generating improvements to the supply chain, however they do not always result in the level of desired improvements. Implementing change, particularly radical change, across an organisation requires buy in at all levels with support at the strategic level and empowerment

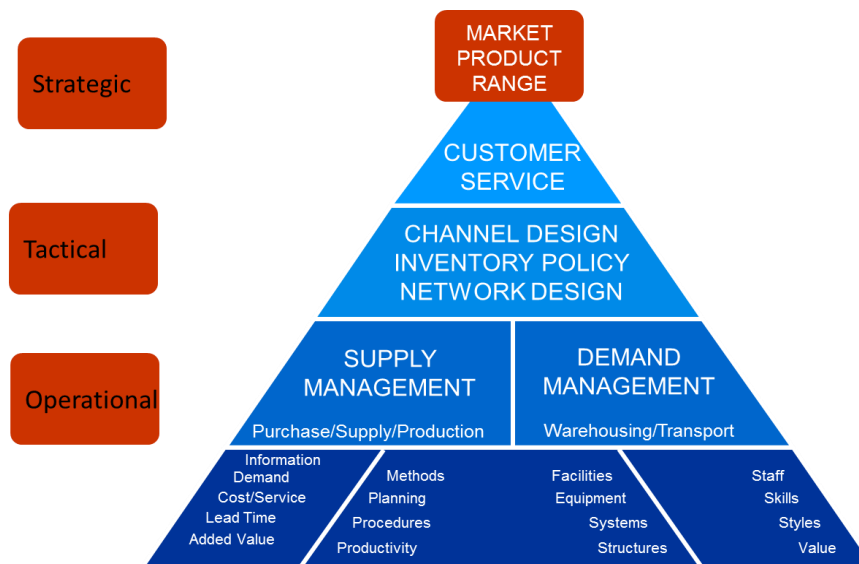
at the operational level (Gunasekaran, Lai, & Edwin Cheng, 2006). One aspect worthwhile considering is how organisations apply responsibility, accountability and authority across the levels of the management model. Some researchers have found that organisational effectiveness increases when subordinates are empowered to act (Kanter, 1979) (Bennis & Nanus, 1985) (Tannenbaum, 1968). Conger & Kanungo (1988) concluded that those who have the power within organisations will achieve their desired goals, those who have no power will be prevented or limited by higher placed individuals in their achievement of goals. In this case power is synonymous with authority; Conger & Kanungo (1988) see power as the formal authority or control over organisational resources. Where authority is not delegated from the planners at the strategic and tactical level to those carrying out the supply chain actions organisational success will be impacted. Spence Laschinger & Wong (1999) concluded that successful empowerment and accountability is dependent on strategic and tactical levels relinquishing traditionally held control, however that most organisations attempts to share or delegate down authority to act was largely superficial. There are a number of reasons why authority is not delegated: empowerment can lead to overconfidence at the operational level, which leads to misjudgement (Conger & Kanungo, 1988); inconsistencies arising from differences in applications of the supply chain philosophy and company policies (Bowen & Lawler, 1992); divulging authority means middle managers lose the power (Blanchard & Bowles, 1998); and subordinates do not have the required skills to make the right decision (Kanter, 1979).

It was highlighted earlier that a good strategy poorly implemented or resourced will have negative results for the organisation. Gray (1999) states that a number of performance categories can be improved upon to enable the good strategy to succeed, with exception of time; time once expended cannot be recovered. Although Gray was discussing the impact of lost time in reference to military operations, it remains true for the supply chain. Speed of response to supply chain changes will impact on an organisation's performance (Gehani, 1995). Empowerment has the ability to reduce delay, particularly in decision making, which is essential in supply chain environments that operate with high levels of uncertainty (Gehani, 1995). Fawcett et al discuss the advantages of creating an empowerment culture that it leads to "knowledge workers", these are workers who "can recognize opportunities, analyse problems, and proactively move to find creative solutions...as well as being able to share key insight[s] across organisational boundaries" (Fawcett, Ellram, & Ogden, 2007).

Figure 13 aptly explains the process business often follow to separate organisational decisions into the three levels. It also shows how the “customer” (the market) shapes strategic vision and or goal, and that such decisions cascade down through the organisation.

Figure 13: Business Model Decision Levels

(Glass, 2017)



The market is the first aspect of the supply chain to be identified – who does the organisation intend to sell to? The NZDF outputs are purchased by the NZ Government annually when the NZDF budget is approved.

The “product” is the roles that the NZ Government requires the NZ Army, the Royal New Zealand Navy, and the Royal New Zealand Air Force to fulfil through the Chief of Defence Force. These roles have been consistent over the last (at least) 17 years; they range from defending NZ’s sovereign territory, assisting NZ population during civil emergencies, supporting civilian efforts in Antarctica, and leading security operations in the South Pacific through to contributing to international peace and security, and being prepared to respond to sudden shifts in the strategic environment (New Zealand Government, 2010) (New Zealand Government, 2016).

The “range” includes the type of equipment or capabilities NZDF procures (with approval of NZ Government) to achieve the outputs, how deploying forces will be structured, how the deployment will be governed (e.g. rules of engagement), and how success will be defined which will allow the NZDF to withdraw. Confirming the range is a two way discussion at the highest levels, between NZDF’s strategic level and the customer. The ultimate decision, however resides with the customer and what they decide to purchase.

Cascading down a step is the strategic level deciding what standard of customer service will be achieved. Essentially determining what resources can be committed to achieve the outputs given budgetary constraints; determining the strategic vision or the supply chain policy to be applied by the tactical level. The tactical level then makes decisions on how to achieve the strategic direction, determining inventory policies and network structures to support the strategic supply chain policy. The operational level then take actions in line with tactical direction and strategic policy, turning theory into reality or a vision into a tangible output. The model shows that the largest portion of the organisation is formed by the base of the pyramid and the smallest portion is the strategic level. This research will not compare or analyse the structure of the NZDF strategic level to determine if it conforms to business practices regarding structure and roles of Chief Executive Office and Board of Directors, and if these have influenced success of NZDF SCM. However the size of each level and where individuals perceive they fit within the organisational levels may be a factor of this research.

2.6 Review of NZDF supply chain drivers

Section 2.5 explains how strategic directive documents shape the structure of all NZDF activities and by default, the organisational management and associated supply chain structure for any outcome that is required at tactical and operational levels. The documents that inform and shape NZDF business includes ministerial documents and flows down to operational level procedural publications. There is a strict hierarchal order of precedence to these publications:

1. Ministerial,
2. HQ NZDF,
3. Service specific documents, and
4. Unit documents.

At the strategic level NZDF supply chain is guided by Defence White Papers, NZDF Annual Reports, Defence Capability Plans, independent reports, and service specific concept documents. At the tactical level the NZDF supply chain is controlled by Defence Force Orders (DFO) that apply to all services and Defence Force Orders for Army (DFO(A)) that pertain only to land matters. At the operational level, operators conform to NZ publications (NZP) that provide detailed procedures regarding equipment management specific to each equipment type and Standard Operating Procedures (SOP) that detail unit specific responsibilities and step-by-step procedures.⁴

⁴ There was insufficient time to review NZPs and Unit SOPs as part of this research. As NZPs are regularly updated it was assumed that they conform to policies and procedures detailed in DFO and DFO(A). Unit SOPs specific to NZLAV may not be updated regularly however it was assumed that as there was only one major

Documents were examined to ascertain what supply chain policy or direction they contained; included in this was an analysis of key supply chain or organisational management terminology – effectiveness, efficiency, responsibility, accountability, and authority.

Defence White Paper 2016

Since the introduction of the NZLAV there have only been two White Papers, 2010 and 2016. The Defence White Paper 2016 outlines the importance of adapting defence policy as NZ's strategic environment continues to evolve. The 2016 White Paper "build on and, where necessary, adjusts the Government's defence policy priorities" (New Zealand Government, 2016), making it an important document to analyse with regards to driving factors for NZDF's supply chain design. There are 12 references to logistics in the 2016 White Paper, two that are relevant to this research. The NZDF has reviewed its command structure, which included centralising its logistics functions under the Chief Joint Defence Services and changing its policies on equipping the force rather than equipping the unit (New Zealand Government, 2016). The intent of this strategic direction is to maintain a high level of effectiveness of deployed forces whilst simultaneously improving organisational efficiency by not unnecessarily equipping the units in NZ.

There are 45 references to effectiveness in the 2016 White Paper, the majority of which pertain to supply chain matters. There are multiple references to NZDF being directed to operate effectively with other forces or organisations. NZDF is also directed to effectively achieve tasks across the full spectrum of operations in NZ and overseas. There are only 14 references to efficiency, 11 of which are tied to effectiveness – "allocating resources efficiently and undertaking tasks effectively" (New Zealand Government, 2016).

With no change in directed outputs, the frequency of the term effectiveness in the 2016 White Paper would suggest that the NZ Army will retain an NZLAV capability until such time that it is replaced with the next equivalent vehicle. This should result in the NZLAV supply chain being protected from efficiency measures (such as low inventory levels, cost reductions, delayed or reduced maintenance schedules) taking precedence over maintaining an effective fleet. It is more likely that effectiveness of the NZLAV capability will be tied closely to efficiency decisions, potentially resulting in a revisions to the NZLAV capability without impacting on directed outputs.

Defence White Paper 2010

The 2010 White Paper was superseded by the publishing of the 2016 White Paper, however it is still relevant as it provides historical context to the development or re-design of the NZDF supply

unit with NZLAV and minor units tend to copy major unit SOP, the status of these SOPs would not influence data results.

chain. There are 57 references to effectiveness, the majority of which pertain to NZDF force elements remaining effective in their ability to achieve directed tasks. Efficiency, cost effectiveness, and affordability feature more strongly in the 2010 White Paper, with affordability having its own entire chapter. There were only three references that linked efficiency with effectiveness and only two that linked flexibility with resilience (New Zealand Government, 2010). Although an effective, flexible, resilient supply chain was a consideration in the 2010 White Paper the drive for an efficient supply chain was significant and was a direct result of the Value for Money Review in 2009.

In the six years between the publication of the 2010 and 2016 White Papers the efficiency measures (including reduction of inventory) implemented by NZDF has resulted in significant cost savings that have been reinvested within other areas of the NZDF (New Zealand Defence Force, 2012) (New Zealand Defence Force, 2016). This drive for cost efficiencies continues to affect all non-core military functions or rear area support, potentially without sufficient consideration into the long term impacts of losing or giving away that function, skill, or capability. Although the 2010 White Paper has been superseded by the more balanced 'efficiency with effectiveness' approach in the 2016 White Paper, it is assessed that cost efficiency will continue to be the primary performance criteria for many.

Annual Reports

The annual reports summarise NZDF's performance of the outputs directed by NZ Government for the preceding year. The five most recent reports were reviewed and it showed that the NZ Army output for land combat forces as directed by NZ Government have been 100% achieved for four out of the five years, with only the June 2016 report returning an 81% achievement score. The ability to achieve 100% of this output for July 2015 – June 2016 was impacted by personnel issues (New Zealand Defence Force, 2012) (New Zealand Defence Force, 2013) (New Zealand Defence Force, 2014) (New Zealand Defence Force, 2015) (New Zealand Defence Force, 2016). The last five annual reports also commented on the supply chain being able to achieve the required performance standards in respects to all current operations (New Zealand Defence Force, 2012) (New Zealand Defence Force, 2013) (New Zealand Defence Force, 2014) (New Zealand Defence Force, 2015) (New Zealand Defence Force, 2016).

The annual reports do not detail the performance measurement method or criteria and they only comment on supply chain performance in regards to all current operations. Operations in the context of the reports is likely to be all current deployments, such as Iraq and Afghanistan; these operations do not reflect all outputs that Government are likely to expect of the NZDF, for

example they do not provide an assessment of the supply chain in the South West Pacific. Therefore these annual reports supports the general statement that the existing NZDF supply chain philosophy meets Government requirement. Without detail on the performance criteria no specific conclusions can be drawn on the efficiency or effectiveness of the NZLAV supply chain, or in fact, any one part of the NZDF supply chain.

Defence Capability Plan 2016

The Defence Capability Plan 2016 details how the NZ Government will invest in capabilities and how the NZDF will be structured beyond 2030. It reflects the security situation, likely deployment environments, outputs, and readiness levels that are detailed in the Defence White Paper 2016. Of particular note is it reinforces that land forces must be capable of deploying a Combined Arms Task Group of battalion size and sustain it for three years (New Zealand Government, 2016). It is this element that the NZLAV would contribute to. The Defence Capability Plan 2016 forecasts a future protected mobility vehicle fleet included in this is how the NZLAV “might be replaced, modernised and/or integrated with other forms of protected mobility in the future” (New Zealand Government, 2016).

Both affordability and logistics have their own sections within the Defence Capability Plan 2016. In regards to affordability the Plan emphasised that capability purchases must ensure a balanced and sustainable NZDF into the future. It also stated that investment in enabling functions, such as logistics, are necessary to ensure success (New Zealand Government, 2016). The logistics section strings adjectives together to explain how the logistics capability will be developed: “timely and efficient support”, “rationalise and enhance processes”, and “greater efficiency and effectiveness to enable savings through cost avoidance” (New Zealand Government, 2016). This would indicate that the supply chain design (or redesign) should be considering a lean, agile, or Just in Time (JIT) philosophies. Yet no supply chain philosophy is stated explicitly, which makes it a challenge to decipher which direction the NZDF needs to follow.

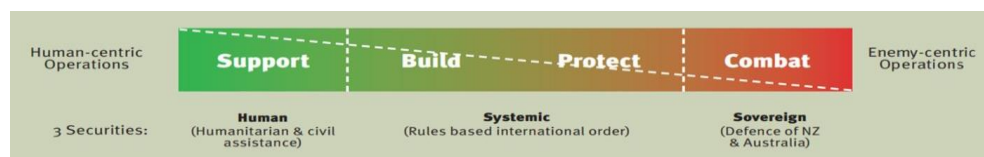
Although the Defence Capability Plan 2016 links efficiency and effectiveness, it goes on to discuss in the same sentence savings through cost avoidance. It is unclear if the author of the Defence Capability Plan 2016 was emphasising efficiency over effectiveness, or if this was a reference to the need to apply systems thinking to capability purchases. The importance of integrated logistics support and whole of life capability costing is highlighted in the Plan and correctly applying these system thinking practices will reduce costs and allow capability decisions to be made within affordability parameters. As a strategic level document informing the future of NZDF supply chain policy or NZLAV supply chain management, the Defence Capability Plan 2016 lacks sufficient

clarity to move forward with. This is likely to result in the cost efficiency measures from the 2010 White Paper continuing to impact on supply chain design.

Future Land Operating Concept 2035

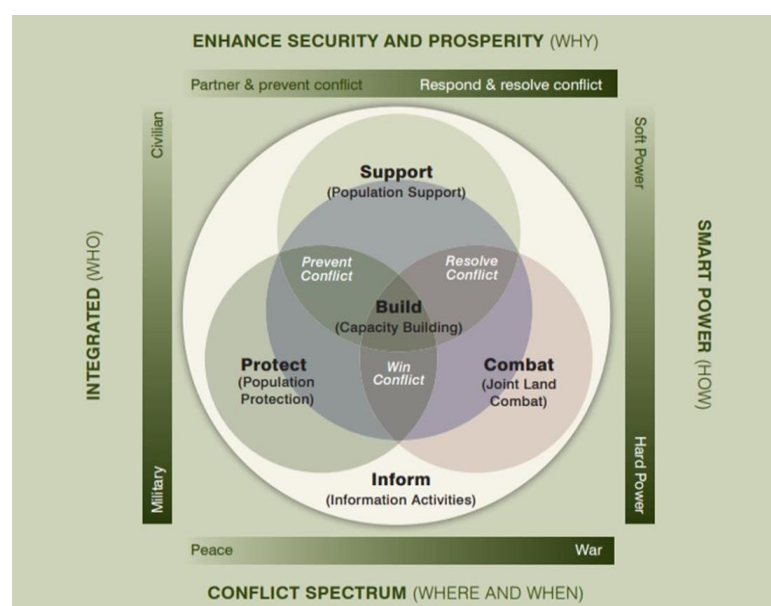
The Future Land Operating Concept 2035 (FLOC 35) provides the overarching construct to how the NZ Army will operate or will need to operate in the future. The traditional view of the conflict spectrum (Figure 14) describes the conflict environment as a linear transition from peace to war, safe to extreme threat, soldier with no combat equipment to a soldier in full combat equipment.

Figure 14: Conflict Spectrum (traditional view)
(New Zealand Army, 2017)



The linear environment described by Figure 14 provides more clarity for the NZ Army's supply chain philosophy or design than the Defence White Papers or Capability Plans. The supply chain in such a linear environment could transition on the left from a lean, optimised, efficient system to a supply chain that must be flexible, agile, with built-in redundancy on the right. The current hierarchal command structure of militaries and their support systems were designed for the combat environment at the right hand end of the spectrum, where success is not defined by efficiency. The traditional conflict spectrum (Figure 14) has been replaced with Figure 15, the Integrated Land Missions model (New Zealand Army, 2017).

Figure 15: Integrated Land Missions Model
(New Zealand Army, 2017)



The new model is not linear, it shows more of the complexities of the environment that NZDF operates or will operate in. The Integrated Land Missions model is multi-dimensional, with military responses never existing entirely in one space. A Humanitarian Assistance and Disaster Relief (HADR) activity, for example Cyclone Winston early in 2017, would sit in the population support space. The response would also need to be cognisant of the inform space and integrated with civilian responses, at the peace end of the conflict spectrum, with a view to partnering and preventing conflict, and using soft powers. An HADR activity would also need to consider building capacity to enable NZDF to exit and limit the need to return. There is potential for an HADR activity to transition from a population support response to population protect response and even, combat response quickly.

This complexity creates conflict within the supply chain design requirements - the NZ Army force element assigned to what initially starts out as a population support response is likely to differ to the NZ Army force element required for a population protect or combat response. An HADR response may be limited in aircraft and ships to move equipment, inventory, and personnel into the disaster area. To maximise the support sent to the disaster area, whether that be number of military, non-governmental organisations (NGO) operators, or inventory or equipment, the supply chain needs to be lean and efficient. However this could be in conflict with the agility and effectiveness if the operation shifts even slightly out of the population support, peace, civilian, soft power, partnering response space.

The FLOC 35 provides guidance for future supply chain design and analysis indicates that 'efficiency' is a key consideration factor as it occurs 11 times within the three pages that discuss supply chain. The rationale for placing efficiency as a key consideration in the future was that the current supply chain design "consumes too much time, too many people, and is too reliant on a resupply chain that is easily interdicted and disrupted" (New Zealand Army, 2017). The FLOC 35 contends that efficiency must be a driver of the supply chain design and theories such as JIT logistics are only relevant supply chain methods where resupply can be assured, where resupply cannot be assured additional capacity will need to be built into the system (New Zealand Army, 2017). The FLOC 35 further contends that the future supply chain must reduce expenses by reducing permanent overhead costs through well managed high value contracts and increasing use of contracts on deployment whilst acknowledging the need for redundancy, operational security, and foresight in the supply chain (New Zealand Army, 2017).

The FLOC 35, as a strategic level document, provides the clearest direction for supply chain philosophy or design of all the documents reviewed; this is achieved through detailing the variety

and complexity of environments that require successful supply chains. One challenge that may be taken with the concept document is the potential conflict in demanding a supply chain efficient in resources and expenses whilst simultaneously demanding a high level of availability, reliability, flexibility, and cognisant of operational security. Supply chain efficiency measures on what appear initially to be restricted to non-deployable aspects of the supply chain can negatively affect the availability, reliability, and flexibility of deployed units. For example reduction in inventory levels in NZ warehouses will save money and make good theoretical supply chain design sense. An aging vehicle fleet, such as the NZLAV, requires more maintenance, this maintenance may end up being delayed due to insufficient inventory level, which will ultimately negatively affect operational effectiveness.

One other factor from the FLOC 35 that needs to be highlighted is the review of processes. The FLOC 35 states that “logistics leaders will need to ruthlessly review processes to reduce unnecessary bureaucratic burdens that undermine combat power” (New Zealand Army, 2017). This research may assist with shaping the review of processes to enhance opportunities for success.

Defence Force Orders

There are two levels of Defence Force Orders: Defence Force Orders (DFO) are publications that pertain to the whole NZDF and service specific publications, for NZ Army these are Defence Force Orders (Army) or DFO(A). DFO 52 Material Management provides policy direction on some aspects of the supply chain. The aim of DFO 52 Material Management is to have a robust, flexible, and reliable materiel support system that is effective and efficient, and enables the NZDF to successfully meet directed outputs (New Zealand Defence Force, 2014). Efficiency does appear to trump effectiveness with activities needing to be “as cost effective as possible” (New Zealand Defence Force, 2014) and inventory holdings reduced. Though efficiency might drive the materiel support system, the system is evaluated on its overall effectiveness (New Zealand Defence Force, 2014).

DFO 52 Material Management details some strategic level responsibilities, less of the tactical level responsibilities, and does not detail any responsibilities that have been delegated to the operational level. However DFO 52 does state that it is “NZDF policy to delegate responsibility, whenever possible, to the lowest extent possible” (New Zealand Defence Force, 2014). Accountability is not discussed in DFO 52, possibly due to the perception that where responsibility has been delegated those individuals will also be held accountable for performance and authority is discussed only once with respects to materiel management system responsibility. Authority to

make changes to aspects of materiel management policy is also limited, with DFO 52 acknowledging that there may need to be some discretion with determining inventory holdings however that can only be exercised within the overall NZDF policies (New Zealand Defence Force, 2014). The policies that govern repair, procurement, and configuration management are specific and the authority to make changes held at the strategic level.

Defence Force Order (Army) Volume 4 (DFO (A) Vol 4) outlines materiel management policies and procedures specific to NZ Army. This policy document provides further detail on strategic and tactical level responsibilities, and some detail on operational level responsibilities as they pertain to the NZDF supply chain. There is no discussion in DFO (A) Vol 4 regarding the authority to make changes to the supply chain policies and procedures, however there is scope to advise higher elements on supply chain matters (New Zealand Army, 2017). Inventory matters within DFO (A) Vol 4 are discussed in terms of efficiency rather than effectiveness; for repair matters efficiency tends to be discussed in conjunction with effectiveness.

Report on Higher-level NZDF organisational arrangements

The primary purpose of this report was to provide the Ministry of Defence and the Chief of the Defence Force with an independent assessment of the “appropriateness and effectiveness” of the accountability, authority, and responsibility arrangements within higher levels of NZDF (New Zealand Government, 2012) post significant structural change. The report defines these three terms as:

“Accountability means being liable for some output or result, for the manner in which it is achieved, and for explaining any failure to achieve the output or result.”

“Responsibility relates to duties to be performed. Anyone assigned to a duty or task is responsible for carrying it out, and responsible to whomever assigned it. More than one person may be responsible for a task, but each is individually accountable.”

“Authority is the power that people have to carry out their responsibilities, and assign authority and responsibility to others.”

The report concluded that there may be confusion at higher levels of the NZDF regarding who can be held accountable for decisions, with a matrix organisational structure and senior leadership “committees” possible reasons for this confusion (New Zealand Government, 2012). The report discusses how authority is applied within a hierarchical structure and how it can influence leadership, with effective leadership requiring both responsibility and authority (see Table 1).

Table 1: Command relationship between authority and responsibility⁵

Pigeau, R and McCann, C (1995) cited in (Lieutenant-Colonel Jon Burbee, 2007)

	Responsibility	No responsibility
Authority	Balanced command	Dangerous command
No authority	Ineffective command	Inability to command

The report indicated that there were some issues regarding a lack of authority being delegated to enable staff within HQNZDF to effect improvements despite being held accountable for those improvements (New Zealand Government, 2012). This report focussed on a small portion of the NZDF however, in terms of the NZDF's hierarchal structure, the personnel involved in this research operate in close proximity to those with ultimate authority and responsibility for NZDF performance and therefore face fewer hurdles when effecting change than the rest of the NZDF. The results of this report regarding failure to delegate sufficient authority is likely to be magnified the further away from the top of the hierarchal structure supply chain participants are.

Summary of NZDF supply chain literature

Strategic business documents should add value to the NZDF by providing clear, consistent direction to enable the tactical and operational levels to act in a manner that takes the NZDF towards its goal. From a supply chain perspective the NZDF literature reviewed has deficiencies that could be addressed. Table 2 summarises the supply chain guidance provided in the NZDF literature reviewed.

Table 2: NZDF supply chain literature reviewed

Document	Guidance inferred	Performance measurement remarks
Annual Reports	The existing supply chain meets the customer's requirements	Four out of five most recent reports stated NZ Army achieved 100% of its directed outputs for the year.
Defence White Paper 2016	Effectiveness features more than efficiency. References to efficiency strongly tied to effectiveness.	Flexible supply chain that can successfully support the NZDF responding to tasks across the spectrum of operations.
Defence White Paper 2010	Efficiency features more than effectiveness. Very limited links made between efficiency and effectiveness.	Achievement of immediate efficiency measures prioritised over effective and resilient supply chain and, in the longer term, a cost efficient supply chain.
Defence Capability Plan 2016	Supply chain policy direction is vague. Effectiveness aimed for within budget constraints.	Greatest efficiency and effectiveness possible within budget.

⁵ Accountability is not discussed by Pigeau and McCann as a separate factor of command, as they viewed accountability as being automatically tied to responsibility.

Document	Guidance inferred	Performance measurement remarks
FLOC 35	Effectiveness simultaneous with efficiency	Reduction in supply chain costs and impact, freeing up resources to remain effective and flexible in primary military role.
DFO 52	Efficiency takes priority over effectiveness. Responsibility to be delegated as far as possible. Authority held at strategic level. Accountability not discussed.	Ability to effectively achieve directed outputs.
DFO(A) Vol 4	Inventory to be managed efficiently, equipment maintenance is to be efficiently and effectively managed. Responsibilities delegated. No direction regarding authority or accountability.	Efficient achievement of directed outputs.
Report on Higher-level NZDF organisational arrangements	To be effective in the achievement of a given task, the individual must be given responsibility and authority.	Where an individual can be identified they will be held accountable for a task, including those where they lacked the necessary authority.

There was no single NZDF document that could be located which details NZDF supply chain policy or a clear, consistent NZDF supply chain philosophy. The Defence White Paper 2016 provides limited supply chain guidance and this guidance is slow to permeate subordinate documents. The FLOC 35 provides the clearest NZ Army supply chain guidance of all the documents reviewed, though this has to be inferred from the Integrated Land Mission Model (Figure 15). Confusion is created for those designing the supply chains by the FLOC 35 requiring supply chain efficiency to be delivered simultaneously with a high level of availability, reliability, and flexibility in order to respond effectively to all NZ Army contingencies.

This lack of coherent direction for supply chain design could see the tactical and operational levels of the NZDF continuing to use old supply chain policy and procedures yet be assessed at or by the strategic and Government level against new performance criteria or expectations. The ambiguity created by these documents will also affect perceptions of how or what responsibility, accountability, and authority is delegated within the NZLAV supply chain. This will, in turn, impede the ability to remove the supply chain bureaucracy that obstructs the performance of fighting elements on operations. Failing to define supply chain performance measurement criteria in strategic level documents, will result in the tactical and operational levels defining their own criteria, and this is likely to change with each commander.

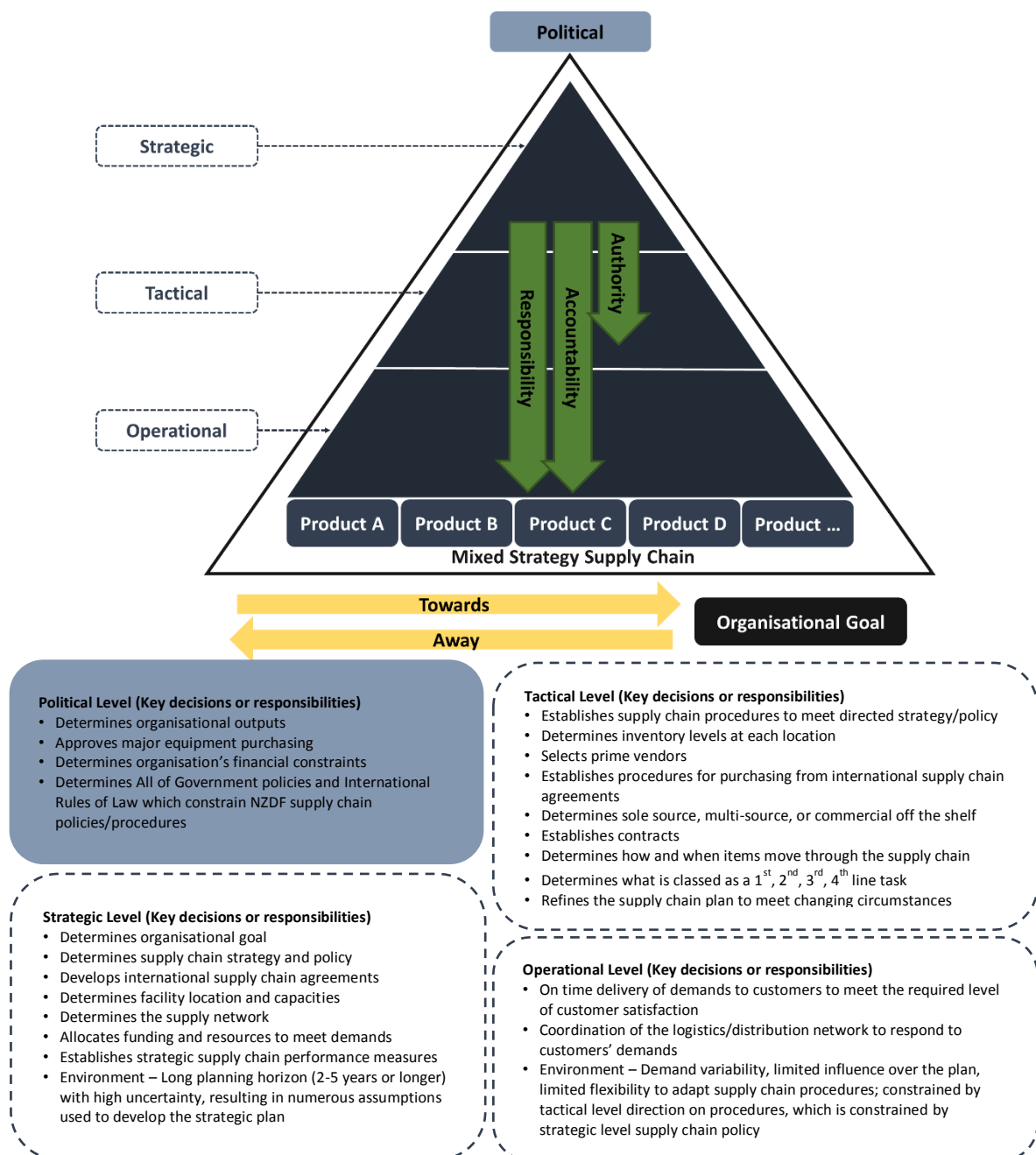
2.7 Research Model

Current Model

Considering the three models “Levels of Management Control” (Houlihan, 1985), “Levels of Military Operations” (New Zealand Defence Force, June 2012), and the “Business Model for Decision Levels” (Glass, 2017), together with thinking from “The Goal” (Goldratt & Fox, 2004) produces the model at Figure 16 detailing the current NZDF organisational management structure.

Figure 16: Current Organisational Management Model

(Author, 2017)



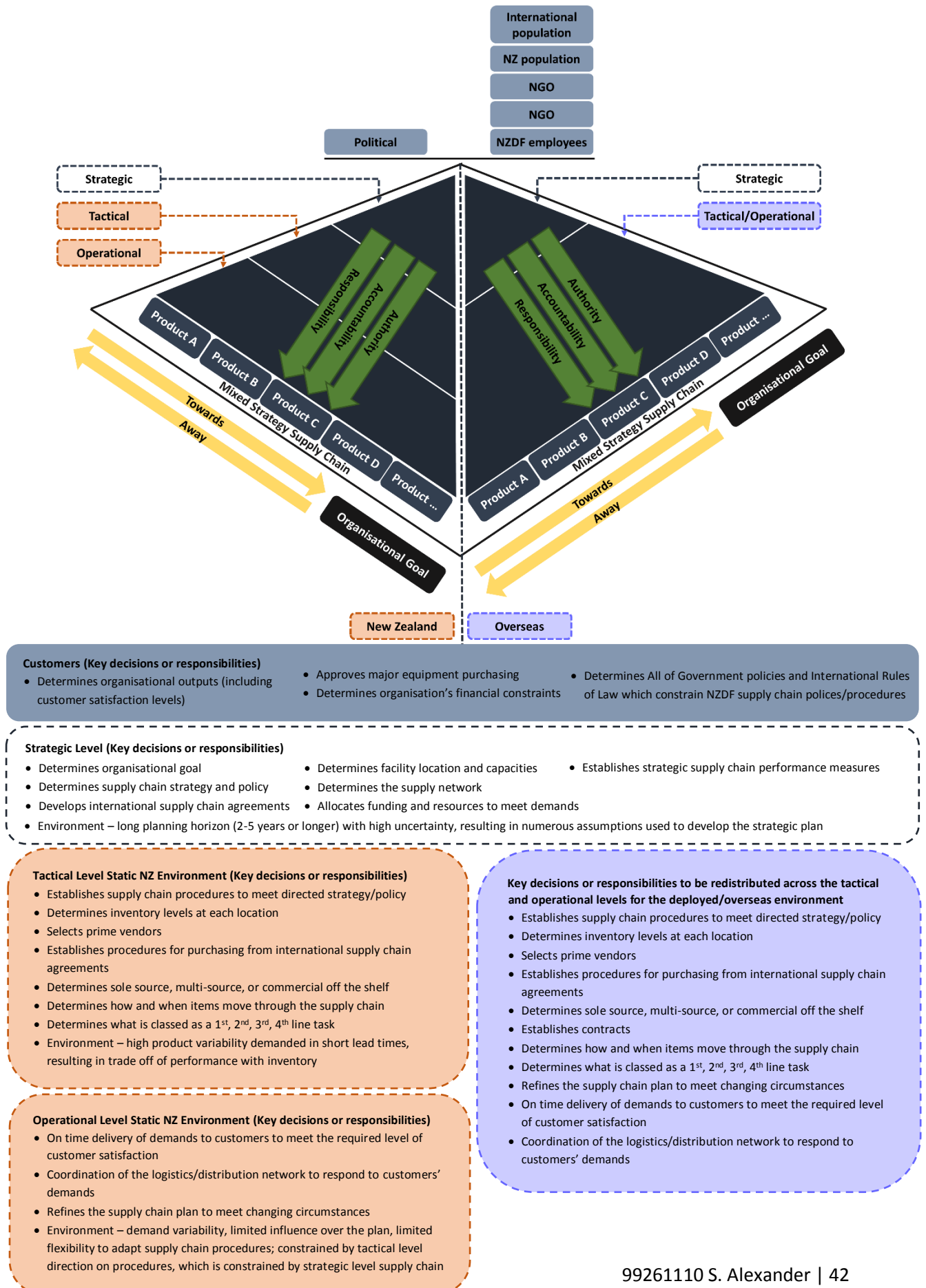
Strategic level decisions of the NZDF are designed to have an impact – ideally, to move the NZDF towards its goal. The strategic level of the NZDF sits within the mixed strategy supply chain environment; it is not separate from it. However a strategic level decision could potentially have a positive effect on Product A (i.e. assist in moving the NZDF towards its goal) and a negative effect on Product B (i.e. move the NZDF away from its goal) because of the difference in environments in which those products are used. This also applies to the tactical and operational levels; Supply chain decisions and actions are intended to move the organisation towards, not away from its goal.

The hypothesis from the current organisational management model is that the NZDF delegates responsibility and accountability for SCM to the operational level however it does not delegate authority. This, combined with the NZDF's hierarchical structure, where rank and positional power has significant influence limits the success of the NZDF. The operational level is not empowered to make or advise any of the necessary changes to ensure supply chain decisions actually move the NZDF towards its goal. The organisational management model, with respect to supply chain roles and responsibilities is rigidly applied to all environments and products. Organisational effectiveness is ultimately constrained by this rigid approach to supply chain design. The freedom of distance, time zone differences and organisational disobedience can mean that operational effectiveness is not constrained to the same extent.

Model for discussion

The organisational management model for discussion in this research is proposed at Figure 17. This model demonstrates the importance of the relationship between strategic supply chain improvement concepts and operational success within a mixed supply chain context.

Figure 17: Proposed Organisational Management Model
(Author, 2017)



This model highlights that the customer for the NZDF's market, product, and range is not only the political masters. NZDF supply chain customers include the international population of the countries the NZDF is deployed in support of, NZ population for civil emergencies, NGO's that NZDF works alongside, other government agencies (OGA) that the NZDF works to for specific tasks, and also the soldiers, sailors, and airmen who operate NZDF equipment.

The pyramid model shows the multifaceted environments that the NZDF deploys in to, where the allocation of roles and decision making capacity, particularly at the tactical and operational levels, needs to be adapted to best suit the specific environment. Figure 17 also shows that responsibility, accountability, and authority for supply chain decisions and ability to provide advice should be delegated to the operational level. This proposed model more accurately explains the complexity that exists when attempting to create a successful supply chain for the NZDF given the current and future simultaneous demands of fiscal restraint (cost effectiveness) and flexibility of outputs (effectiveness in multiple environments).

2.8 Research Gap

The variability of supply chain contexts has resulted in the creation of the various supply chain strategies that organisations can apply to improve their supply chain management. With the wealth of supply chain management strategies available the one consensus appears to be that one supply chain improvement strategy cannot be applied to all stages of the chain or to all products within the chain. Multiple organisational management models also exist, with research showing the importance of applying the correct model for the environment. Therefore if the context is sufficiently important that it drives the type of supply chain strategy used and the type of management model employed then there is a need to understand how to consider, in advance, the performance trade off that exists between the various supply chain and management strategies.

The research gap is a model that adequately guides the application of supply chain policy for hierarchically structured organisations that need to perform successfully in multiple environments.

2.9 Summary of important aspects of literature

One key aspect of the literature through which this research will be viewed is the relationship between supply chain uncertainties (Lee, 2002) and performance measurement (Beamon B. M., 1999). Figure 10 demonstrates how performance criteria or customers' expectations of potential performance are weighted depending on the supply chain context; therefore failure to change the supply chain design to specific environment or product circumstances will affect

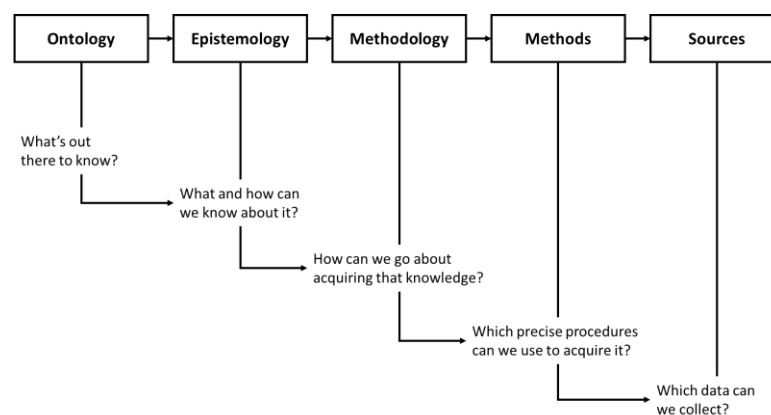
organisational performance. A second key aspect of the literature that informs this research is the predominance of hierarchical structures and the inflexibility of those structures once established (Magee & Galinsky, 2008). Success is not determined by applying a particular organisational management model, but rather a relative advantage given to those organisations that can shift their management model to the current or future context over those organisations who do not adjust. In regards to this particular case study it is necessary to understand how organisation specific literature shapes the organisation being researched. For the NZDF it is necessary understand the hierarchal management structure, in particular how strategic guidance results in the achievement of organisational goals through the delegation of responsibility, accountability, and authority to the tactical and operational levels. For the NZDF, the vagueness of strategic direction for supply chain design coupled with the continued adherence to old guidance is likely to negatively impact on organisational goals and also customers' attitudes. Enforcing the static NZ based supply chain design regardless of deployed environmental context or product type is unlikely to produce a resilient and flexible supply chain that successfully supports multidimensional military responses on deployments.

3.0 Research Methodology

3.1 Ontological and epistemological perspectives

Research commences from an ontological perspective that will affect the research path; it is important to know what can be known, but initially it is necessary to understand what perspective knowledge can be viewed. The ontological perspective of objectivism, is one where an act has an independent existence; the act is the “real world” and unaffected by external sources (Johnson, Onwuegbuzie, & Turner, 2007). At the other end of the scale is constructivism, which is where the act is developed through its existence, it is affected by the environment around it at the time it occurs (Morgan, 2007; and Bryman & Bell, 2011). As highlighted by Grix (2002) (see Figure 18) and Hay (2002), epistemology follows on from ontology.

Figure 18: The Interrelationship Between the Building Blocks of Research
(Grix, 2002)



Epistemology is the theory of knowledge – what and how something can be known (Blaikie, 2000). The epistemology position of one's research will be linked to the ontological perspective. Positivist epistemology is linked to ontological objectivism, as the “real world” is researched without influence from the researcher and the researcher's views are not affected by the “real world” (Guba & Lincoln, 1994). At the other end of the epistemology scale is interpretivism, in which there is a transaction of knowledge between the act being researched and the researcher (Guba & Lincoln, 1994). Bryman and Bell (2011) highlight the need for the researcher to understand the context of the act and the act to understand the researcher in order for the truth to be properly known. Interpretivist epistemology is linked to ontological constructivism. As Plato, in Grix (2002) points out, neither ontological perspective nor their subsequent epistemological position is wrong or right, they are both valid realities. It is necessary for researchers to understand this about themselves, as it will affect how valid they perceive the literature and previous research they review and also how they conduct their own research.

Objectivism and constructivism are polar opposite ontologies with weaknesses that cannot be counted entirely by their strengths. The world is not completely “real” and unaffected by external sources nor completely constructed; there are rules that govern our existence but our existence is impacted by the context. Pragmatism is another ontological perspective from which to consider approaching research. To truly understand reality it is necessary to examine the act from multiple perspectives (Johnson, Onwuegbuzie, & Turner, 2007), hence Plato’s comment about different but equally valid realities. To put it into perspective with the literature discourse above, there is a necessity to understand both the rules of system dynamics and the interactions within supply chains (that being interactions between organisations involved in one supply chain and also the interactions between the levels (strategic, operational and tactical) within the same supply chain). The rules that govern system dynamics have proved theories regarding supply chains, however the applicability of those results to all supply chains are contingent on the context in which organisations are operating. In pragmatism’s attempt to mitigate the weaknesses of objectivism and constructivism by viewing the world as both real and constructed, it lends itself to be challenged as results steaming from such research may not be considered applicable by objectivists or constructivists.

3.2 Methodology and research strategy: quantitative versus qualitative research methodologies

There is the argument that research methodology should flow from the researcher’s ontological and epistemological perspectives (Grix, 2002). Objectivism lends itself towards quantitative analysis, while constructivism is more towards qualitative analysis. Quantitative research is fact based, it is about the real and tangible, the empirical evidence O’Leary (2014). It is a deductive process that tests a theory (Bryman & Bell, 2011); its scientific basis results in a perception that it is unbiased and therefore more accurate. This perception is based on the fact that the research is able to be replicated. On the other hand qualitative research understands that the truth can be subjective, constructed and have multiple answers (O’Leary, 2014). It is an inductive process from which theories can be generated and the rigid rules of scientific research are generally rejected to allow freedom of individual perspective (Bryman & Bell, 2011). The depth of understanding that can be gained from qualitative research can be considered an advantage as well as a disadvantage as the context of the research is critically linked to the results, therefore the theories generated are only applicable in like contexts (Bryman A., 2007). Pragmatist ontology values both inductive and deductive knowledge (Johnson, Onwuegbuzie, & Turner, 2007), therefore quantitative and qualitative methodologies are relevant to the pragmatist.

When researching supply chains neither quantitative nor qualitative methodologies alone will generate an accurate understanding of the truth or “real world”. When viewing this topic from the lens of system dynamics understanding the influence people have on the system is as important as and potentially more important than obtaining an unbiased appraisal of the system. Because people are involved in the supply chain system there is potential that the correct strategic decision was made but people below that level have had a negative influence on the end result. Equally the reverse could happen. Therefore it is necessary to understand the people within the supply chain and the rationale behind their decisions. A mixed methodological approach is likely to be necessary to generate valid conclusions for research involving supply chain management, particularly where the focus is on implementing improvements to the supply chain and the interactions between the strategic thought process and tactical and operational level impacts.

The objectivist ontological perspective with its bias towards quantitative methodology may appear to produce more scientific results, but such methodology will only tell part of the story. As such this research will be from a pragmatist’s ontological perspective, utilising both qualitative and quantitative methodologies.

A case study research approach utilising both qualitative and quantitative methodologies, provides in this instance an in-depth analysis within specific parameters. The parameters in this case being one specific item of equipment within NZDF. Widening the parameters is possible but potentially time consuming or could result in diluting the understanding of the situation. There is scope for this study to be repeated looking into different equipment to see if the results are replicated or widening the study to look at multiple equipment simultaneously to determine the broader supply chain implications.

3.3 Research design considerations

The first three building blocks of the research process (Grix, 2002), as outlined in Figure 18, have been discussed in sub-sections 3.1 and 3.2. The next block is methods, which includes what procedures will be followed to obtain the required knowledge. These procedures are also referred to as research design considerations, which is a plan for how the research is to be conducted.

Cooper and Schindler detailed eight factors to be considered when planning research (Cooper & Schindler, 2008). The research design considerations that will be used to shape this research are outlined below in Table 3.

Table 3: Design Consideration Summary
(Cooper & Schindler, 2008)

Design Consideration	Approach	Remarks
Degree of research question crystallisation	Formal	Formal study is designed to test a hypotheses or answer a stated research question.
Method of data collection	Communication	Communication study requires interaction with the participants to collect their responses.
Control of variables	Ex post facto	In ex post facto design investigators have no ability to manipulate the variables, they can only report what is or has happened.
Purpose	Causal-explanatory	In causal-explanatory study attempts are made to explain relationships between variables.
Time dimension	Cross-sectional	Cross-sectional studies are conducted once and represent respondents' opinions/views/perceptions at one point in time.
Topical scope	Case study	Case studies emphasizes detailed contextual understanding of limited events or interrelationship between variables.
Research environment	Field conditions	Studies conducted in field conditions are not replications of the desired environment but rather they are the actual environment being studied.
Participants perceptual awareness	Routine	Of the three levels of perception outlined by Cooper and Schindler, this study will result in participants perceiving no deviations from everyday routines.

This research will utilise a “Case Study” approach, where the organisation’s goal remains constant but the supply chain environment varies. The intent is to use the NZDF’s supply chain as the case study, with the organisational goal being the operational availability of the NZLAV. Three different supply chain contexts already exist with the NZLAV:

- Used in NZ where there is low demand and low supply uncertainty;
- Used overseas on training exercises where there is high demand uncertainty and low supply uncertainty; and
- Used overseas on deployment where there is both high demand and high supply uncertainty.

The NZLAV supply chain was selected for the case study as it is sufficiently complex to generate data across the three organisation management levels, multiple environments, and throughout all facets of a supply chain. This supply chain is discrete enough to enable control over data variables, allowing greater certainty that data returned is specifically attributed to the NZLAV supply chain. A case study of the NZLAV means that research findings are likely to be attributable

to a wider audience. The nature of the equipment is specific to the NZDF, however many organisations have equipment that is of a similar level of technical complexity and requiring special handling or treatment throughout the supply chain. A case study of land based equipment was considered more appropriate as it enabled supply chain contexts to include remote sites and the challenges that exist with air, sea, and land movement.

This research will be conducted in three stages:

Stage 1. Initially this research will seek to determine the timeline of changes to the NZDF's strategic supply chain policies and provide an understanding of actual NZLAV supply chains and organisational models used. This stage is necessary as it will identify what policies were in place that may have had an influence on the NZLAV supply chain and confirm the existing organisational model.

Stage 2. This stage will include an evaluation of available electronic data on NZLAV fleet performance, targeted surveys and, if necessary, interviews of those personnel with experience in the NZLAV supply chain. Targeted interviews may be necessary to expand on the data provided by the survey, providing a "real world" understanding of how the strategic policy influenced the success (or not) of the supply chain.

Stage 3. This research will conclude by comparing the results and data produced from the first two stages with the proposed model to determine what organisational management changes are necessary to improve performance of deployed NZDF supply chains.

3.4 Data collection methods

The final building block of research described by Grix (2002) (Figure 18) is regarding sources, namely what data can be collected. There are two types of data: primary and secondary. Primary data is original and un-interpreted information, with secondary data being information that has been subject to interpretation at least once (Cooper & Schindler, 2008) (Ghauri & Grønhaug, 2005). By virtue of its characteristics it could be assumed that primary data is superior to secondary data, because there is less potential for errors to have been induced. One key advantage secondary data provides to this research is in enhancing the researcher's understanding of the topic and problem and subsequently enabling the research question to be defined. This is largely achieved through the literature review stage. Being able to classify data as primary and secondary enables a researcher to use the data appropriately for the value it adds to the topic. Data needs to be classified further to allow the correct statistical analysis techniques to

be selected (David & Sutton, 2011). David and Sutton (2011) further refine data into levels of measurement as per Table 4.

Table 4: Levels of Measurement (David & Sutton, 2011)

Level of Measurement	Description
Interval/Ratio Variables	This is quantitative data that is on a continuous scale and can be ranked. Interval variables have no true zero point (e.g. time, temperature). Ratio variables have a true zero point (e.g. distance, age).
Ordinal Variables	Such data can be ranked but the distance between responses cannot be measured. The most common example of ordinal variables is attitude survey questions requiring responses from strongly agree to strongly disagree.
Nominal Variables	This is qualitative data that can be recorded but cannot be ranked. Such variables are known as dichotomies – only two responses; Yes or No.

There is a hierarchy of variables, not necessarily from a superiority perspective, but rather what other forms the data can take. Interval/Ratio variables can be turned into ordinal variables, and ordinal variables can become nominal variables; however the reverse cannot occur. Understanding what levels of measurement can be generated from survey questions will assist in shaping the phrasing of the questions. Table 5 outlines the type of measurements, data to be generated and expected analysis for this research.

Table 5: Data Collection Methods

(Cooper & Schindler, 2008)

	Measurement	Expected analysis
Stage 1	Study of the New Zealand Defence Force strategic level discourse regarding supply chain management. Current policies specific to NZLAV supply chain. New Zealand Government directed output for NZLAV. NZLAV supply chain and organisational management model used for exercises in NZ and overseas, and for operational deployments. Likely to produce Interval/Ratio, Ordinal, and Nominal variable types of data.	Track the intended changes in supply chain management strategies. Timeline of the discourse. Intended/expected benefits of the changes. Provides an understanding of the existing policy restrictions placed on the supply chain and organisational models applied. Informs the organisation's goal. Overall analysis of this stage is to provide the context for survey questions and also the analysis of the resulting data.

	Measurement	Expected analysis
Stage 2	<p>Perspectives on previous NZLAV supply chain examples and how policy has impacted the organisation's goal.</p> <p>Perspectives on what decisions are made or responsibilities are held at the Strategic, Tactical and Operational levels in relation to NZLAV supply chain examples and also how these could be adapted.</p> <p>Likely to produce only Ordinal and Nominal variable types of data.</p>	<p>Examples of the impact (success or failure) of implementing the supply chain management strategies on the operational availability/effectiveness of NZLAV.</p> <p>Examples of the impact of the current organisational management model on the operational availability/effectiveness of NZLAV. Overall analysis is to understand perspectives of previous or existing NZLAV supply chains.</p>
Stage 3	<p>Measuring the status quo against the proposed organisational management model.</p>	<p>In order to consistently move the organisation towards its goal, an organisation operating in a mixed strategy supply chain environment must be able to adapt its organisational management model to ensure responsibility, accountability, and authority are delegated to the appropriate level to ensure organisational flexibility remains.</p> <p>Otherwise successful implementation of strategic decisions will ultimately move an organisation away from its goal.</p>

3.5 How data will be analysed

Large portions of the data generated from this research will be qualitative in nature, which lends itself towards content analysis and narrative discourse analysis. Content analysis, as described in (David & Sutton, 2011), seeks to classify data responses as specific individual units; the data either fits into one category or it does not. This type of analysis enables a researcher to quantify how many responses fit into each category. Ordinal and nominal data responses that can be categorised will initially be subjected to content analysis. Nominal data resulting from open ended questions will be analysed using narrative discourse analysis. Narrative discourse analysis is “interested in the constructions of meaning given at the point of telling” (David & Sutton, 2011). Kohler Riessman (1993) recommended three areas for a researcher to focus on when analysing narrative discourse: life stories, critical events, and poetics. For this particular research understanding the narrative will be guided by Kohler Riessman's foci. For example repetition across respondents' comments could indicate an important event, as could a single example or the first example from a respondent could indicate primacy of that event in the individual's mind. These could be examples of critical events. When considering poetics, the structure of responses and language used may need to be interpreted with consideration to the individual's position or experience within the organisation. There will also be a need to consider the relationship between

the earlier ordinal and nominal data responses and the available narrative discourse as this may provide context to the individual's life story. Content analysis enables researcher to describe or compare results, but not necessarily explain or predict. Narrative discourse analysis has the potential to describe, compare, explain and predict, however the research benefits from using content analysis to guide and support narrative discourse analysis.

3.6 Validity and reliability

Bryman and Bell (2015) discuss the applicability of the terms, validity and reliability, to qualitative research. Validity and reliability imply an ability to measure a variable, measurement being a key aspect of quantitative research. The concepts inferred however are still relevant to qualitative research. To limit confusion this research will use Lincoln and Guba's ((1985) in (Bryman & Bell, 2015)) criteria for assessing qualitative research. Lincoln and Guba's (Lincoln & Guba, 1985) criteria of authenticity has been excluded from this discussion of validity and reliability as it has not obtained a wide level of influence in social research design. The criteria described in Table 6 adequately discuss the topic of research validity and reliability as it pertains to qualitative research.

Table 6: Validity and Reliability Criteria for Qualitative Research
(Lincoln & Guba, 1985) in (Bryman & Bell, 2015)

Criteria	Parallel to	Description
Credibility	Internal Validity	Research procedures meet expectations of good research practices and the members' studies have the ability to confirm the researcher's view of their world.
Transferability	External Validity	The depth of research is such that context is too unique for the results to be transferred to other populations. Research findings and context has to be described in sufficient detail for others to judge transferability of findings.
Dependability	Reliability	External or peer review (audit) of the data obtained and processes followed were proper. Inferences made by the researcher are assessed to determine what level they can be justified.
Confirmability	Objectivity	The level to which the researcher has prevented their personal views and/or perceptions impacting on the conduct of the research or subsequent findings.

3.7 Ethical considerations

The primary reason ethical guidelines exist is to ensure participants are protected from harm and risk (Bernard, 2013). Even voluntary involvement in research does not result in participants forfeiting some or all of their rights. This research will be governed by the Massey University Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants (Massey

University, 2015) and the Defence Force Order 3, Part 14, Chapter 5 Authority to Conduct Personnel Research (Defence Force Order 3).

The NZDF requires endorsement from the Defence Personnel Executive on the design and content of the proposed research before the Assistance Chief of Personnel will consider approving the researcher to proceed (Defence Force Order 3). These two steps enable the NZDF to satisfy organisational requirements which include consulting with command and management personnel of those potentially affected by the proposed research, appropriateness of research timing, financial impact, the ability of the NZDF to act upon the information resulting from the research, and if the research meets the needs and desires of the organisation (Defence Force Order 3).

The Massey University research code of conduct provides significant detail on how to conduct ethical research; however there are four areas, which are intertwined, that have particular relevance for this proposal. The risk of harm to participants is possible with emotional distress from reawakening stressful incidents that may have occurred on deployment to Afghanistan (McFarlane, 2010). As a result of this, participation in the research for those who were deployed must remain optional. It is possible for the NZDF to direct the attendance of participants to an interview, however as the researcher is also a military member there is a potential power relationship that may inhibit responses, therefore informed and voluntary consent and participation must remain a key aspect of this research (McFarlane, 2010).

In line with this is the need to respect privacy and confidentiality of respondents – although the survey and interview numbers are likely to be small which would make it easier to identify respondents. There is no requirement to collect detailed demographic data and this will enhance participants' confidentiality (McFarlane, 2010). Specifically demographic data relating to age, rank, and trade will not be captured. Data relating to the type, level and length of involvement will be captured; this will enable participants' responses to be analysed according to the involvement they have had within the supply chain, whilst simultaneously making it exceptionally difficult to attribute response to specific individuals .

As the researcher is currently employed by the NZDF and works in the topic area there could be the perception of a conflict of role or interest (McFarlane, 2010). To mitigate any bias the survey and any subsequent interview questions will need to be checked by independent parties. Approval by Defence Personal Executive has been directed as a requirement before proceeding with the survey or interviews. Prior to this occurring they will also be peer reviewed and vetted by the research advisor. This research is designed to review the organisation not individuals.

Conclusions resulting from data analysis needs to be constructive and aimed at improving the organisation, rather than endeavouring to point blame at individuals for perceived failures. Consideration in the phrasing of survey and interview questions will be necessary to capture data about organisational behaviours rather than individual's performance. This approach would also enhance the applicability of findings to other organisations. It is possible (with a very low probability) that information will be raised with the researcher that indicates inappropriate or criminal behaviour. If this occurs then the researcher would raise the matter with both the military and university supervisor and consider terminating or suspending the research.

Overall this should be considered low risk research towards individuals.

4.0 Data Analysis

The purpose of this research was to analyse the influences of supply chain design and success within the construct of the organisational management levels (strategic, tactical, and operational) and suggest a potential alternative model, which considers the multitude of operational environments that the New Zealand Defence Force's (NZDF) supply chains need to support. This chapter will first explain the NZDF context, then analyse electronic equipment management data and survey responses. The chapter will conclude by summarising major findings and insights of data analysis.

4.1 NZDF supply chain environment

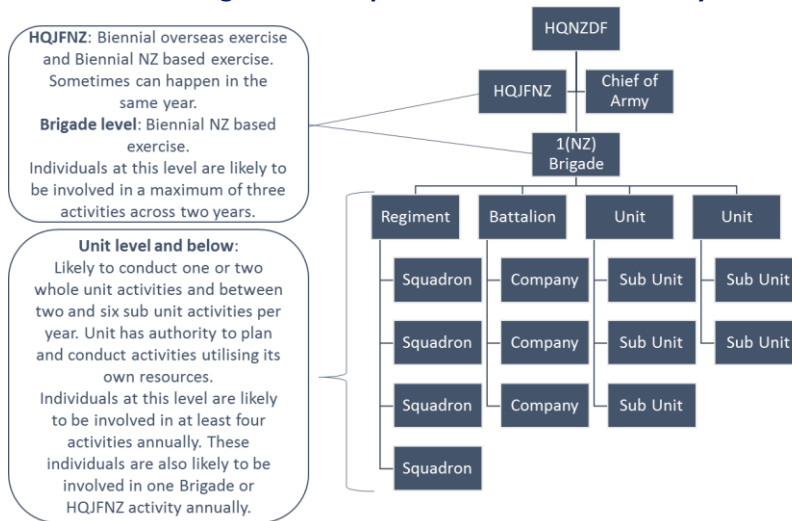
Prior to analysing the research data it is necessary to explain the NZDF context, not to show its uniqueness, but rather to enable understanding and allow findings to be considered applicable to other organisations including non-military organisations. Militaries apply the levels of organisational management terminology differently to commercial organisations; the tactical and operational level terms are reversed for the military, with the tactical level being the lowest in the hierarchal structure (see Table 7). The survey was written for the understanding of the NZDF respondents only and therefore applied the military use of the terminology. However to enable commercial understanding and to ensure consistency throughout this research paper the survey results have been adapted, with commercial use of the terminology applied. As such, when discussing survey responses, the tactical level will represent the middle organisational level and the operational level the bottom organisational level.

Table 7: Differences in hierarchal management terminology

Military Terminology	Commercial Terminology
Strategic	Strategic
Operational	Tactical
Tactical	Operational

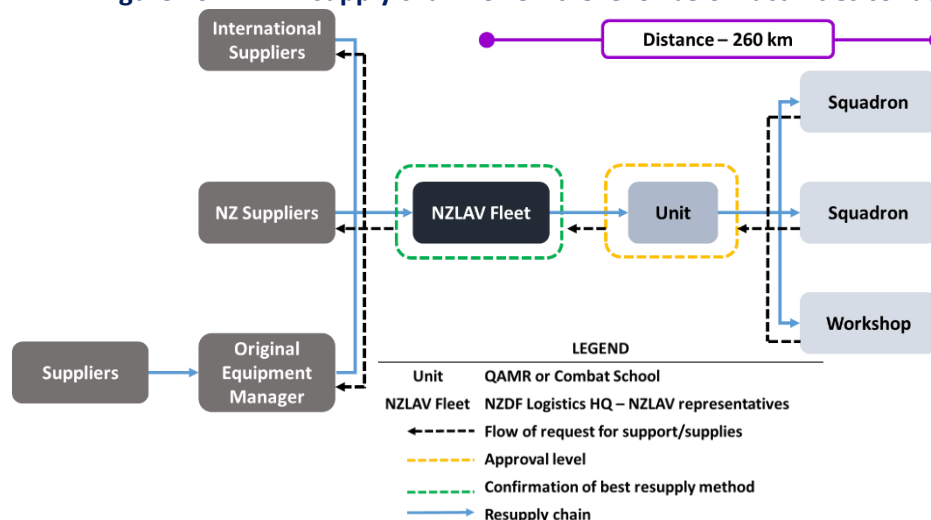
Figure 19 is a simplified version of the NZDF – HQJFNZ – NZ Army organisation designed to show the hierarchal relationship of activity categories that were used in the survey. This hierarchal structure is common to all NZDF services (Army, Navy, and Air Force) and most international militaries. Using a mining company that operates nationwide: Unit level and below would be everything at one mining site, Brigade would be the North or South Island Headquarters that can direct the reallocation of resources from one site to another or reprioritisation of tasks within the island only, and HQJFNZ is the National Company Operation Cell that directs all operations.

Figure 19: Simplified structure of NZ Army



The NZDF is not a production organisation, with a supply chain that receives raw materials at one end and manufactures a finished product for distribution. The NZDF supply chain network can be represented by Figure 1 (Lambert, Cooper, & Pagh, 1998), where it receives finished products (and at times raw materials) from a multitude of suppliers. These are funnelled through a focal point, being the NZDF warehouses or units, and are then demanded by or issued to consumers of NZDF resources. These consumers could be other NZDF units, external commercial companies conducting work for NZDF, and other customers such as civilian population and OGAs. Figure 20⁶ is a simplified view of the supply chain for exercises in NZ involving New Zealand Light Armoured Vehicles (NZLAV) at Unit level and below.

Figure 20: NZLAV supply chain for Unit level or below activities conducted in NZ

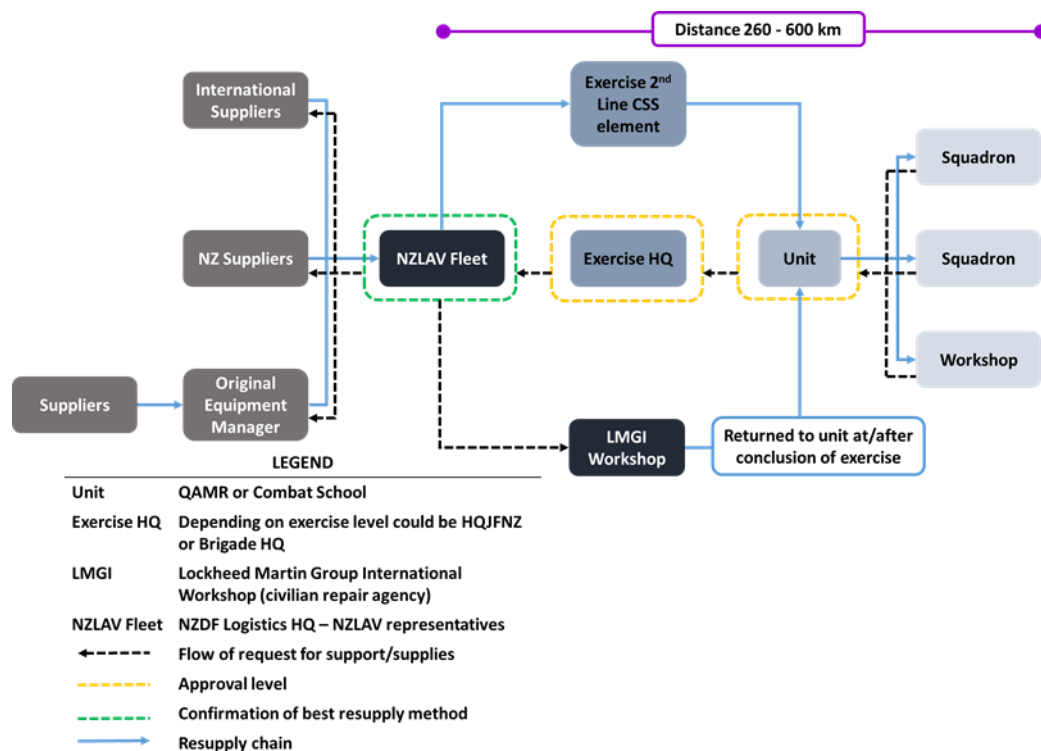


⁶ Figures 20 – 23 are graphical representations of the NZLAV supply chains for the four activity categories. Only a small portion of these supply chains can be observed from electronic SAP data, an analysis of hard copy paperwork or locally held electronic documents is necessary to view all ‘suppliers’ and subsequent ‘consumers’ of the NZDF supply chain.

For Unit level and below, exercises are generally conducted over a short period and in close proximity to the Unit's permanent location where additional inventory and spare vehicles are held. The supply chain for this activity category has less approval steps, however the involvement of external organisations (International or NZ Suppliers or OEM) is limited due to the short duration of the exercise. Attitudes towards the appropriateness of the supply chain for Unit level and below exercises are expected to be higher as the Unit is largely in control of the supply chain, however negative comments are still possible as the exercise supply chain is influenced prior to the exercise period by the remainder of the supply chain participants.

Figure 21 is a simplified view of the NZLAV supply chain for exercises in NZ at Brigade or HQJFNZ level.

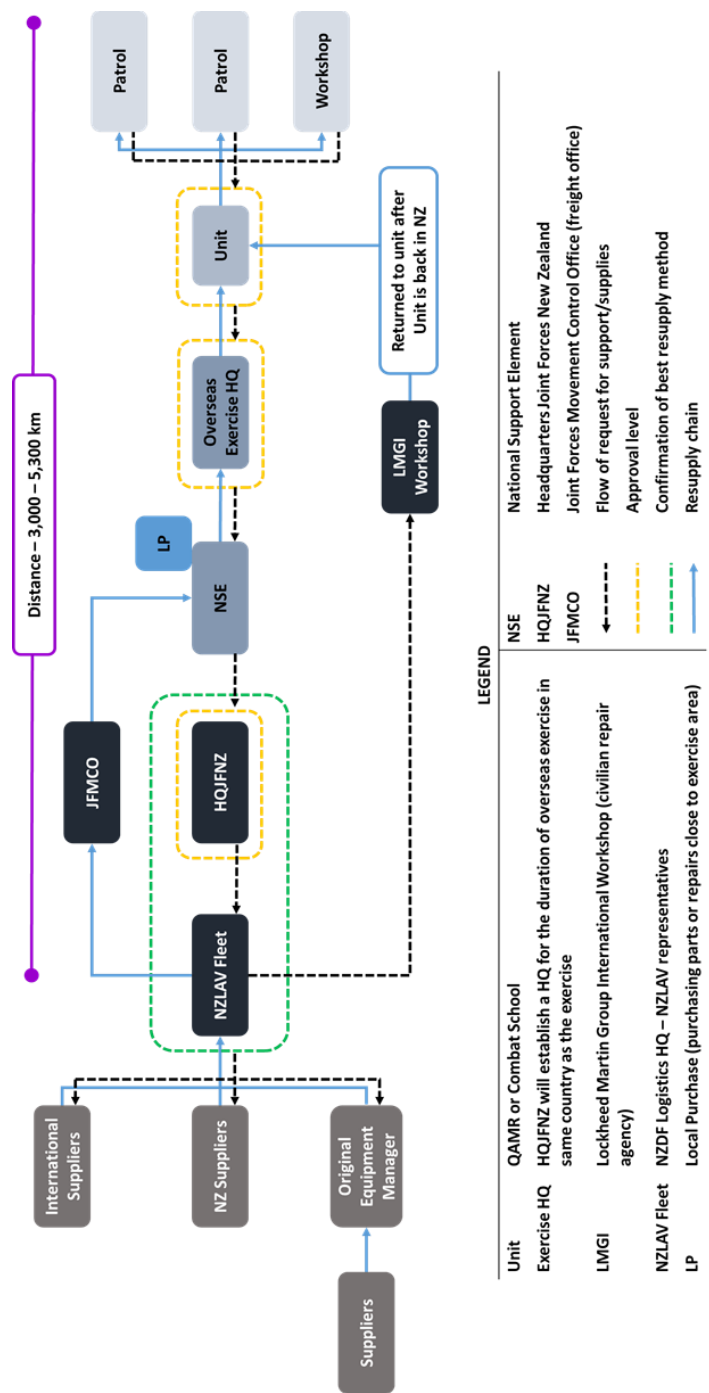
Figure 21: NZLAV supply chain for Brigade or HQJFNZ activities conducted in NZ



For Brigade and HQJFNZ level, exercises tend to be longer in duration, include significant mobilisation (preparation) and demobilisation (clean up) phases, and be further from the Unit's permanent location. There is greater opportunity for external agencies to be directly involved in the supply chain for these activities due to their extended period. There is potential that additional delay can be created in the supply chain due to exercise HQ processing time, limited resources to move demands through the chain, and differences in priorities for those limited resources. This additional delay may impact upon survey respondents' attitudes.

Figure 22 is a simplified view of the NZLAV supply chain for overseas exercises.

Figure 22: NZLAV supply chain for overseas exercises



One key difference between Figure 22 and the NZ based activities in Figures 20 and 21 is the increased distance between NZLAV Fleet and the patrol on exercise. This creates additional delay, not just in extra transportation time, but also the involvement of additional nodes with their own priorities and data processing requirements. However there is scope for the National Support Element (NSE) to purchase parts or servicing requirements close to the exercise area (referred to as local purchase). Existing (and regular) commercial freight options between NZ and Australia

and the proximity of large heavy vehicle transport to most exercise areas is likely to impact on attitudes of survey respondents; where they may be less willing to accept a decrease in performance merely due to increase in distance. The supply chain depicted in Figure 22 is a temporary chain established for each exercise; same country, different training ground.

Figure 23 is a simplified version of the NZLAV supply chain for overseas deployments.

Figure 23: NZLAV supply chain for overseas deployments

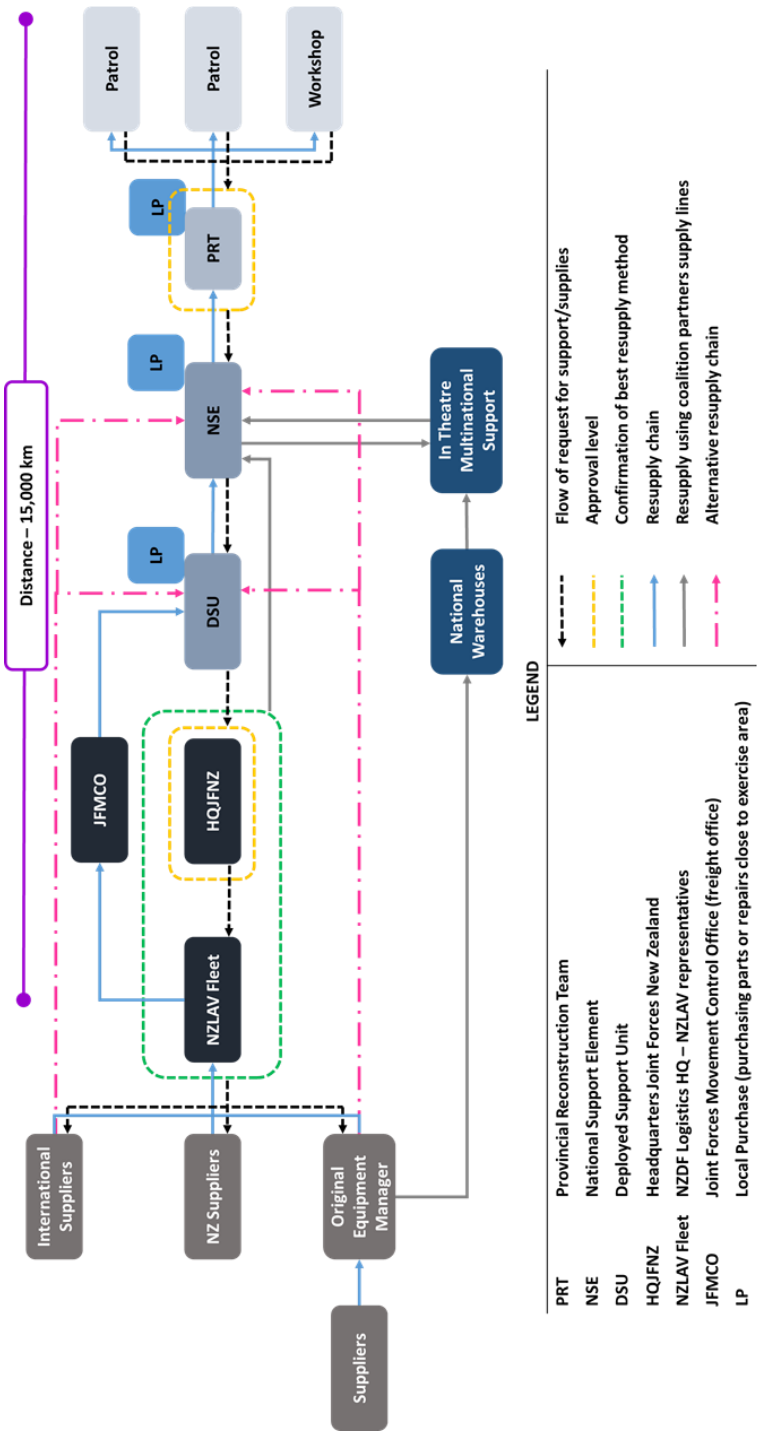


Figure 23 is initially more complex to construct than Figure 22, however it is established over a longer period of time and is, essentially, a permanent supply chain. The distance from Wellington, New Zealand to the only NZLAV overseas deployment location of Bamyān, Afghanistan is over 15,000 km. There is not a direct air link between New Zealand and Afghanistan; with military flights stopping at the Deployed Support Unit located in the Middle East, which creates additional delay. Given the more permanent nature of the supply chain there are additional resupply options available to support the deployed vehicles, which has the potential to reduce the delay. Where the Provincial Reconstruction Team (PRT) does not hold necessary inventory or is not able to conduct the repair, authorisation is needed from NZ to determine the right supply chain, with NZ often being the ones who need to process the demand. The increased distance and limitations on alternative freight options impacts significantly on transportation time, however it is likely to be tolerated, to a certain extent, by survey participants. The delay created by holding authority for supply chain decisions in NZ may be considered unnecessary by survey participants and reflected in survey results.

4.2 Electronic data for NZLAV equipment reporting

The purpose of this section is to assess historical electronic data on the availability status of NZLAV for subsequent comparison with the survey results and comments. The NZDF uses an enterprise application software called Systems, Applications, and Products (SAP) to manage, amongst other things, its equipment and inventory. SAP enables NZDF to track equipment engineering data over the course of its life; this is often referred to as Reliability, Availability, and Maintainability (RAM) data. Reliability is the probability that equipment will perform as designed with minimum risk of failure; Availability is ability of the supply chain to retain equipment in a serviceable state; and Maintainability is the speed or ease with which equipment can be repaired or maintained (Stapelberg, 2009). Correctly applied during the engineering design phase, consideration of RAM factors can reduce number of failures and minimise the consequences of those failures for new equipment, potentially resulting in a lower whole of life cost and improved availability. Saraswat and Yadava (2008) provide an overview of the RAM engineering methods in use by industry and researchers from 1988 to 2005, given the timeframe these may have influenced the design of the NZLAV.

This research will not be analysing the RAM design methods used to determine the influence of the design phase on the supply chain, however some RAM factors are relevant for assessing the performance of the NZLAV supply chain. This research will focus on the availability metric as the method for assessing the performance of the NZLAV supply chain as it accounts for both the reliability and maintainability properties of the system (weibull.com, 2007). There are several

different measures of availability; three that will be considered are Inherent Availability (A_I), Achieved Availability (A_A) and Operational Availability (A_O). A_I is the availability of equipment factoring in only downtime due to repair action (weibull.com, 2007). A_A is similar to A_I however it also factors in preventative maintenance (servicing) downtime (weibull.com, 2007). Inherent and achieved availability do not factor in supply, distribution or administrative delays; they are performance metrics for assessing the suitability of the repair function of an organisation. A_O is the actual availability experienced by the customer and includes all downtime or delay factors (weibull.com, 2007); A_O could be used as a performance metric for assessing the whole supply chain.

SAP availability report

Figure 24⁷ details annual operational availability as calculated by SAP for the NZLAV fleet. For the purposes of research modelling it was assumed that NZDF would be required by its customers to maintain 80% availability⁸.

Figure 24: Predicted NZLAV operational availability with the minimum required availability

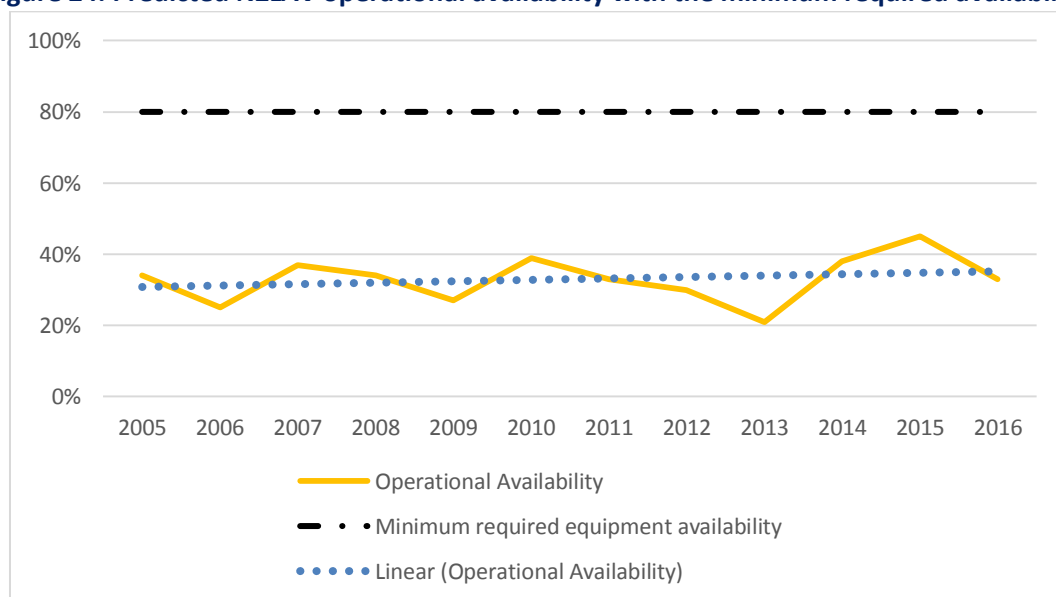


Figure 24 displays the SAP A_O data graphically, showing a significantly underperforming fleet with a positively trending A_O . The SAP A_O formula is based on averages without consideration of removing outliers which could skew results. Introduced errors that create outliers could include failing to uplift the vehicle immediately after repairs completed increasing the ALDT or inclusion

⁷ Data for Figure 24 operational availability was obtained from SAP BI Plant Maintenance Report 002 Operational Availability – report variables: Year 2004-2017; Material Numbers 982058012, 982058013, 982058015; and Functional Locations QAMR, 16 Fd Regt, Cbt Sch, 2 Engr Regt.

⁸ This is an assumed figure for the purposes of research. Due to security reasons the actual figure used by NZDF cannot be confirmed.

of planned servicing as a maintenance task decreasing the MTBM. It is likely that the actual availability of the NZLAV fleet is significantly higher than is reported using the SAP A₀ calculation.

Evaluating actual NZLAV fleet management performance

Actual performance can be evaluated by considering immediate operational availability at specific points of time, using NZLAV fleet management data. Work orders (repair tasks) are raised on SAP to enable planned maintenance tasks or unplanned repairs⁹ to be conducted on an individual item of equipment. Where an NZLAV has an open work order on a selected date it is considered to be offline and unavailable for tasking. Open work orders for NZLAV were counted for selected dates throughout the year – quarterly on 1 March, 1 June, 1 September, and 1 December – from 2004 to 2016. 1 December selected as it is prior to Christmas close down and after the conclusion of the last major exercise of the year. This method will provide a snapshot of equipment performance.

It is acknowledged that equipment will fail and it is necessary to understand how the supply chain responds to these failures. The NZDF continues to train throughout the year on the same vehicles it would be required to deploy with. The NZ Government has directed the NZDF to provide responses to security events but NZLAV are not always required to deploy immediately. In NZ, where supply and demand uncertainty is low, an Efficient Supply Chain strategy can be employed. As per Figure 10, the use of resources is the primary performance measure. This is demonstrated by the time built into the supply chain to respond to NZ Government requirements – training on vehicles deploying would cease, allowing these vehicles to be repaired and readied for deployment.

Figure 25¹⁰ provides an annual summary of the immediate equipment availability and availability status post the appropriate notice to deploy¹¹, these are also compared with an assumed performance assessment criteria.

⁹ Planned maintenance for NZLAV is time based in accordance with OEM servicing schedule. Unplanned repair tasks are raised on occurrence, when identified by the operator or by the workshop tradesperson during a planned maintenance task.

¹⁰ Data for Figure 25 NZLAV availability was obtained from SAP report IW39 Display PM Orders – report variables: Outstanding, In Process, Completed, Historical; Material Numbers 982058012, 982058013, 982058015; Functional Locations QAMR, 16 Fd Regt, Cbt Sch, 2 Engr Regt; Period 1.07.04-30.06.17; Layout S. Alexander.

¹¹ For security reasons it is not possible to confirm what the minimum notice to move that was used for the purposes of modelling in this research or what the actual notice to move is for NZDF.

Figure 25: Annual NZLAV availability status as at 1 December 2004 – 2016

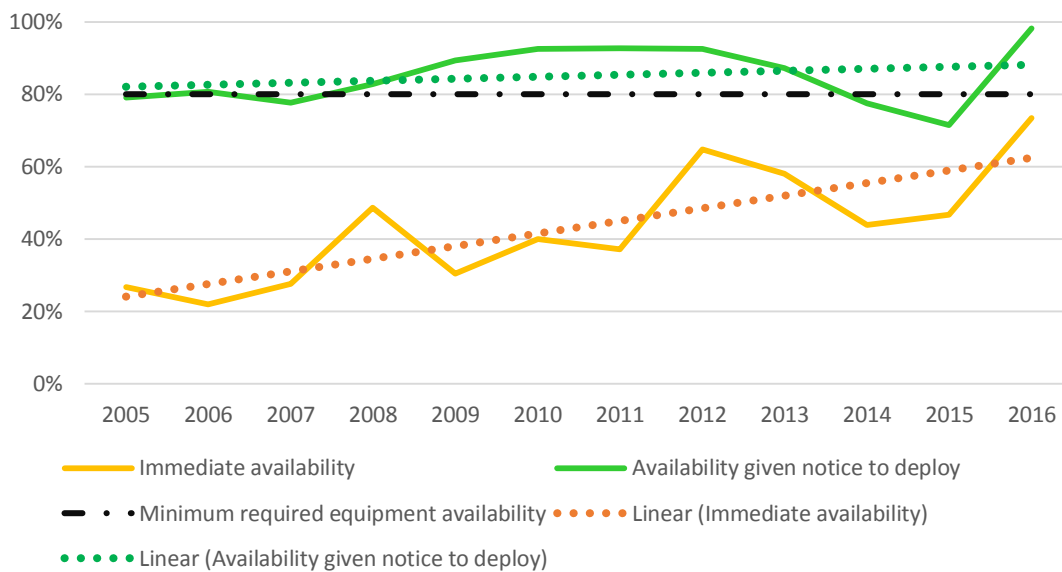
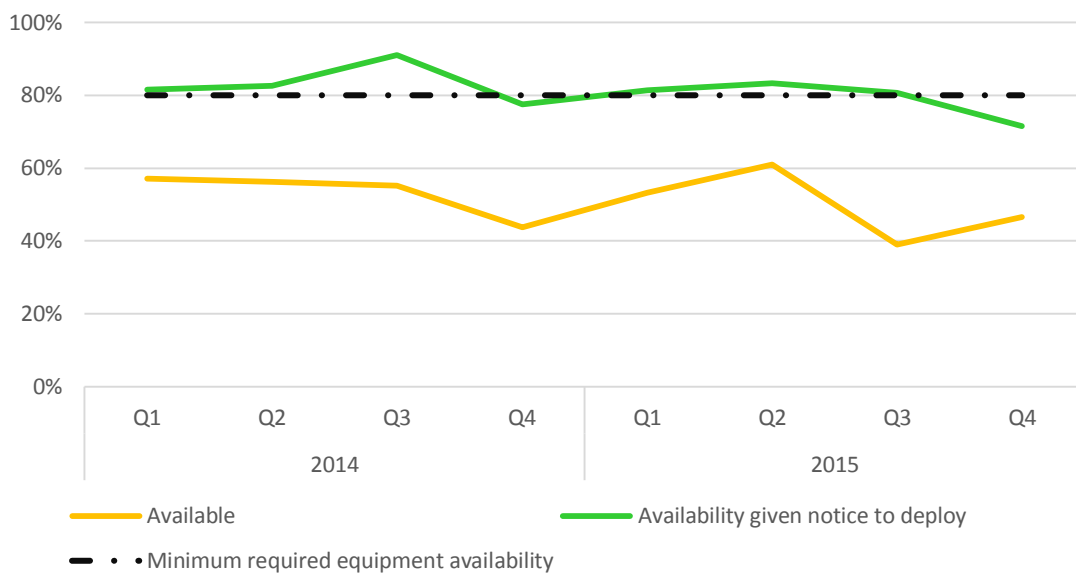


Figure 25 shows that the highest immediate availability was 73% in December 2016, which is 40% above the predicted operational availability shown in Figure 24. Figure 25 shows that the immediate availability is always below the minimum required availability as expected by its customer being the NZ Government. Figure 25 also shows that the availability given the appropriate notice to deploy exceeds the minimum requirement on all but four years; the average availability post the appropriate notice to deploy is 85% and the highest availability was 98% in December 2016. Notably over the period that the NZLAV were deployed to Afghanistan (2011 – 2013) the fleet was able to be maintained to above the minimum required level.¹² When viewed from a macro level, nine out of 12 years of meeting or exceeding the performance target set, would suggest that the NZLAV supply chain is effective. This should be reflected in positive survey results for effectiveness and positive survey comments on supply chain performance. This fleet maintenance data is available at Annexes A – C and is displayed quarterly for the period 2004 – 2016.

Figure 26 provides a quarterly view of performance for 2014 and 2015. Historical information was not able to be obtained on possible reasons for a dip in performance in 2005 and 2007.

¹² This data includes NZ vehicles and it would not have been a simple task of swapping a serviceable NZ based vehicle with an unserviceable vehicle in Afghanistan.

Figure 26: Quarterly NZLAV availability status for 2014, 2015



Viewing 2014 and 2015 by quarterly performance as in Figure 26 shows that three out of four quarters of 2014 and 2015 the supply chain performed above the 80% minimum. The dip in performance in quarter four of 2014 was possibly due to increased use of NZLAV on Brigade and overseas exercise towards the end of the year (New Zealand Army, 2014) (New Zealand Army, 2014) (New Zealand Army, 2014). The dip in performance in quarter four of 2015 was possibly due to Exercise Talisman Sabre 15, a multi-national military exercise in Australia, which included NZLAV (Quilliam, 2015). The Talisman Sabre exercise series is a high tempo kinetic exercise in unfamiliar terrain that is designed to test military responses at the higher end of the threat spectrum. The increased off-road driving in complex terrain to complete combat exercise scenarios increases the potential for vehicle damage; increased damage translates to increased maintenance requirements, which may impact upon vehicle availability. These dips in performance are expected and, from a macro organisational perspective, is not sufficient evidence to suggest degradation of supply chain effectiveness.

Comparison of availability status with failure rates

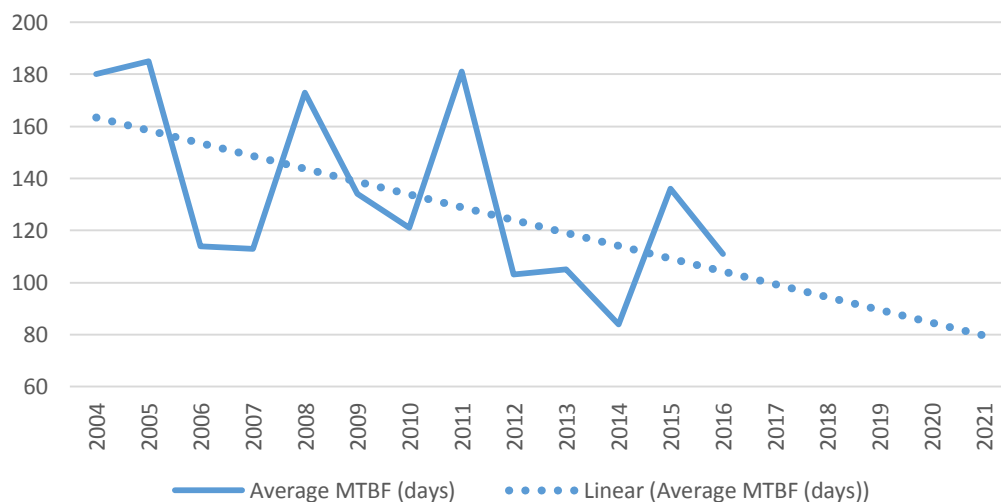
According to the actual performance data the NZLAV supply chain is effective at meeting the customer's requirements, providing the appropriate notice to deploy is given. Understanding the rate at which equipment fails may also provide context to survey responses. This rate of failure is referred to as the mean time between failures (MTBF). Table 8 provides the annual MTBF in days for 2004 – 2016.

Table 8: NZLAV MTBF 2004 - 2016

Year	Average MTBF (days)	Year	Average MTBF (days)
2004	180	2011	181
2005	185	2012	103
2006	114	2013	105
2007	113	2014	84
2008	173	2015	136
2009	134	2016	111
2010	121		

Table 8¹³ data includes a random sample of 20 NZLAV Infantry Mobility Vehicles (IMV), all NZLAV Engineer vehicles and all NZLAV Recovery Vehicles. All engineer and recovery vehicles were included as there are so few of them that they deployed more frequently in support of the IMV variant potentially resulting in a higher failure rate. A random sample of 105 NZLAV could result in excluding the engineer and recovery variants altogether, this would result in a MTBF figure that is not reflective of the customer's requirements which includes all variants. This data excludes planned servicing, pre-fire inspections, road user certifications, and exercise inspections. Although these are considered down time, they are not considered unplanned failures.

Figure 27 displays the MTBF data graphically with a linear trend analysis.

Figure 27: NZLAV MTBF 2004 – 2016 with trend line to 2021

A high MTBF figure is a positive, as it shows there is a longer time between unplanned failures. A low or decreasing MTBF figure is a negative, as it indicates a reduction in fleet performance. Figure 27 shows that the MTBF is decreasing for the fleet, with a vehicle requiring unplanned

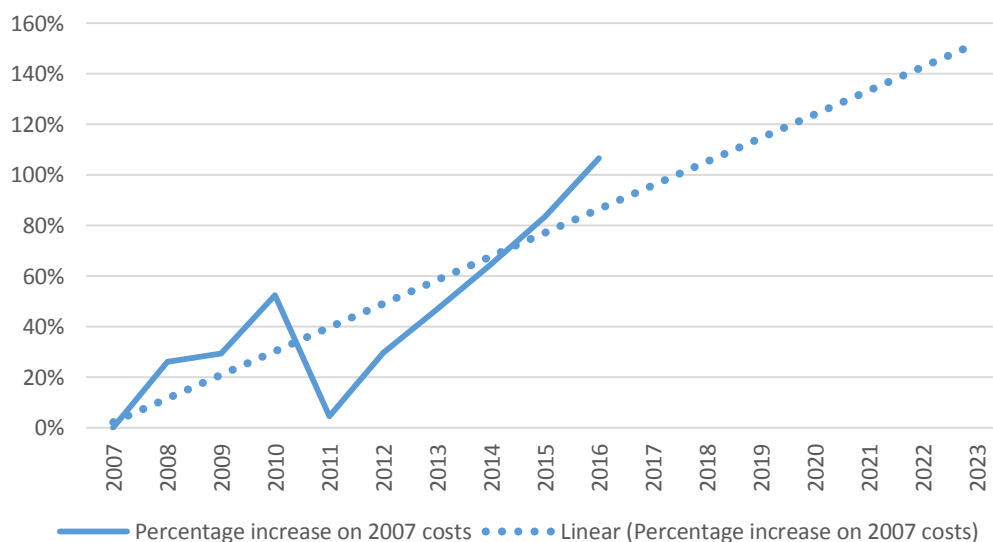
¹³ Data for Table 8 Mean Time Between Failure was obtained from SAP BI Plant Maintenance Report 006 MTBF – report variables: Year 2004-2017; Material Numbers 982058012, 982058013, 982058015; and Functional Locations QAMR, 16 Fd Regt, Cbt Sch, 2 Engr Regt.

maintenance every 111 days in 2016, compared to every 180 days on 2004. A linear trend analysis (Excel) indicates that MTBF for the fleet could decrease to below 100 days by 2017 and below 80 days by 2021. A decreasing MTBF figure is likely to be reflected in negative survey results and comments.

Analysis of cost factors

Equipment availability, factoring in the appropriate notice to deploy, has been sustained above the assumed minimum of 80% for the majority of the life of NZLAV to date, despite a decreasing MTBF rate for the fleet. It would be expected that as equipment ages and its MTBF decreases the cost to sustain the fleet will increase. How much it increases is potentially dependant on RAM engineering decisions made during the design phase but it will also be dependent on supply chain decisions such as inventory holdings, distribution options and minimum level of equipment availability required by the customer. Most RAM engineering decisions cannot be altered post production, however other supply chain decisions can be changed and therefore future performance can be more effective or efficient. Figure 28¹⁴ summarises the increase in repair costs for the NZLAV fleet, utilising the 2007 expenditure as a start point and includes a linear trend analysis.

Figure 28: NZLAV repair costs 2007 – 2016 with trend line to 2023



¹⁴ Data for NZLAV availability was obtained from SAP report IW39 Display PM Orders – report variables: Outstanding, In Process, Completed, Historical; Material Numbers 982058012, 982058013, 982058015; Functional Locations QAMR, 16 Fd Regt, Cbt Sch, 2 Engr Regt; Period 1.07.04-30.06.17; Layout S. Alexander. This data includes actual work order repair costs only, it excludes original purchase costs, inventory holdings, or soldier personnel costs. Data prior to 2007 was not included as aspects of the vehicles were covered by warranty.

Figure 28 shows that it cost NZDF twice as much to maintain the fleet in 2016 compared to 2007 and a linear trend analysis (Excel) out to 2023 shows that this figure could increase by another fifty percent. The significant reduction in cost in 2011 is possibly due to change in training priorities resulting from Afghan deployment, where one rotation of NZLAV crews were deployed overseas and next rotation training to deploy may have reduced the training hours in the vehicles as crews needed to conduct theatre specific training for Afghanistan. Factors that could be influencing the increasing costs are increased unplanned maintenance requirements resulting from an aging fleet (this is supported by the decreasing MTBF figure), increased obsolescence of parts where manufactures are choosing not to continue to produce certain product lines, increased maintenance tasks occurring due to increased availability of repair personnel. Increased training time would also be a factor to consider as this would increase opportunities for failure.

It is not possible to conclude from this data that the supply chain's efficiency is decreasing as the whole of life costing methodology would have factored these cost increases into the project costs at the start.¹⁵ Regardless of the possible reasons for increasing costs the decision to maintain a high level of supply chain effectiveness for the NZLAV fleet that has decreasing MTBF has resulted in the NZDF's expenditure doubling over the last decade. This would suggest that the NZLAV fleet has not been subjected to significant cost saving decisions to improve the fleet's apparent efficiency. It would be reasonable to expect that this prioritisation of effectiveness over efficiency will be reflected in high levels of satisfaction from survey respondents.

4.3 Survey data

The survey (see Annexes D and E) was approved by NZDF for release early August 2017 and was sent out by email to those in the survey population that were identifiable by name. The survey was also sent to commanders and managers of units or workplaces that may have contained the survey population; these commanders and managers were asked to disseminate the survey to their staff. NZDF research coordinators limited the timeframe of this survey due to other NZDF research being conducted in September; a completion date of 31 August 2017 was set for the survey responses. Limited responses were forthcoming early in the month from electronic distribution. Hardcopy survey forms were provided which improved the response rate. The survey form was proceeded with an information sheet detailing the purpose of the research, types of

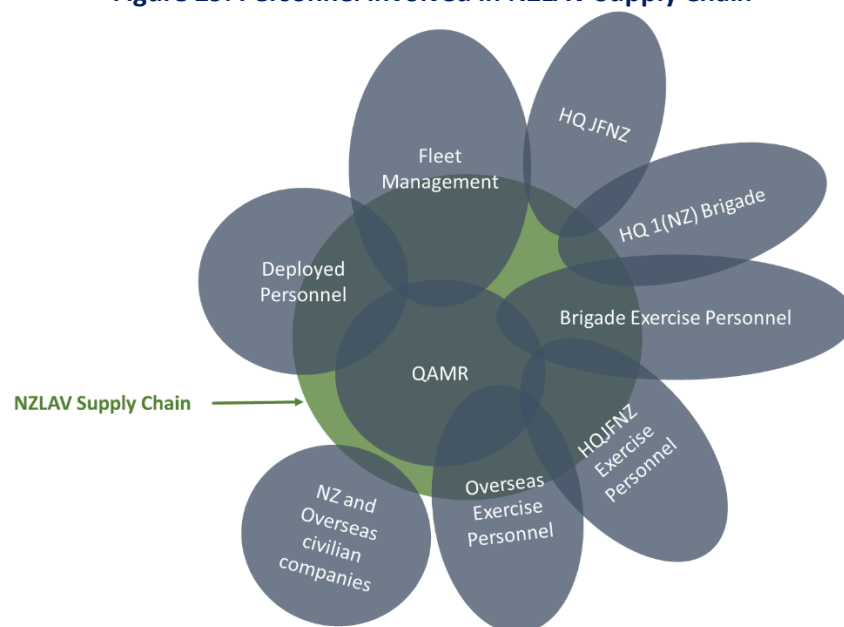
¹⁵ Other measures of efficiency not assessed as part of this research were: over or under stocking of inventory that results in increased equipment downtime as well as increases in warehousing and inventory management costs; obsolescence analysis to review the point at which it will cost more to maintain the fleet than to replace it; and the point at which the NZDF will not have sufficient hours per day with the current personnel resources to effect timely repairs. This analysis was considered to be outside of the scope of this research.

participants requested, explaining the process of the survey, how data collected will be protected, what will happen to results, and provided contact details if individuals had further questions about the research or conduct of the survey. To ensure individuals only responded once to the survey an anonymous research code was used to identify each survey response.

The survey commenced by asking participants to consent to the conduct of the survey and whether they would agree to be interviewed by the researcher if further detail was required. All respondents consented to participating in the survey. However only 32% of respondents were willing to participate in an interview and of those only 65% of them provided a valid email address to enable an interview to be coordinated.

Figure 29 depicts the survey population in relation to this research.

Figure 29: Personnel involved in NZLAV Supply Chain



The survey population includes personnel from the Unit (Queen Alexander's Mounted Rifles (QAMR)), Headquarters, exercise participants (overseas exercises, HQJFNZ exercises, and Brigade exercises), deployed personnel, fleet management, and also civilian organisations in NZ and overseas¹⁶. Excluding overlaps in involvement the survey population was assessed to be 235. There were a total of 64 respondents, giving a survey response rate of 27.23%, though not all survey participants answered each section as not all 64 had participated in all activity categories.

The survey consisted of four sections: demographics, the individual's view of NZLAV supply chain in NZ, the individual's view of NZLAV supply chain overseas, and wider NZDF supply chain policy.

¹⁶ Due to research constraints a separate survey of civilian organisations involved in the NZLAV supply chain was not conducted.

The questions were organised by activity category to focus respondents on the supply chains for those activities. The four activity categories were: Unit level and below, Brigade and HQJFNZ, Overseas exercises, and Overseas deployments.

Survey questions generated primary data in the form of interval/ratio (e.g. length of time with NZDF), ordinal (e.g. level of the NZDF worked at – strategic, tactical, and operational; attitude based – strongly agree to strongly disagree), and nominal variables (e.g. yes or no questions). There was also scope within the survey to provide comments relevant to that portion of the survey. Survey data analysis will be presented according to its relevance to supply chain topics not specifically to the activity categories used in the questions. The topics that will be analysed are demographics, effectiveness and efficiency, empowerment and desire to operate outside prescribe policy, NZDF supply chain policy, and delegating and listening to subordinates.

Activity category ratings will be considered using the alternative contextual performance model for assessing mixed strategy supply chains (Figure 10). This model combines Beamon's Supply Chain Measurement System (Beamon B. , 1998) which factors in resources (efficiency), output (customer service), and flexibility (effective response to changing environment) with Lee's Matched Strategy model (Lee, 2002) where supply chains should be designed dependant on how they are affected by supply and demand uncertainties.

The activity categories 'Unit level and below' and 'Brigade and HQJFNZ' are likely to have a supply chain that is affected by low supply uncertainties and low demand uncertainties. This would indicate that a highly efficient supply chain is possible, where the focus is on efficient use of resources rather than maintenance of high level of customer service or a highly flexible supply chain. The overseas exercise activity category is likely to have a supply chain that is affected by high demand uncertainty and low supply uncertainty. This suggests a responsive supply chain is possible, where flexibility influences supply chain decisions over customer service and efficiency of resources. The overseas deployment activity category is likely to have a supply chain that is affected by high demand uncertainty and high supply uncertainty. This suggests an agile supply chain is required, where achievement of outputs (customer satisfaction) and flexibility are crucial to success.

The raw data generated from survey responses was entered into Excel workbook, ensuring that respondent's anonymity was maintained. This data has been collated by survey question and is included at Annex F.

4.3.1 Survey Demographics

Section 1 of the survey collected respondents' demographics on position and experience within the NZLAV supply chain. The survey questions for Section 1 were:

Number	Question
1.1	How would you classify your involvement with the NZLAV supply chain?
1.2	Which level of the NZLAV supply chain was your involvement at? (if you operated across more than one level, please select the level you spent the most time at)
1.3	How many years' experience have you had with the NZLAV supply chain?
1.4	How many years have you been with the NZDF?

Additional survey data for these questions can be found at Annex F, Tables I – IV and Figures I – II. The term supply chain in the NZDF is synonymous with “logistics”; unfortunately neither term engenders much interest from non-logisticians within the NZDF. This backed up by survey response comments such as:

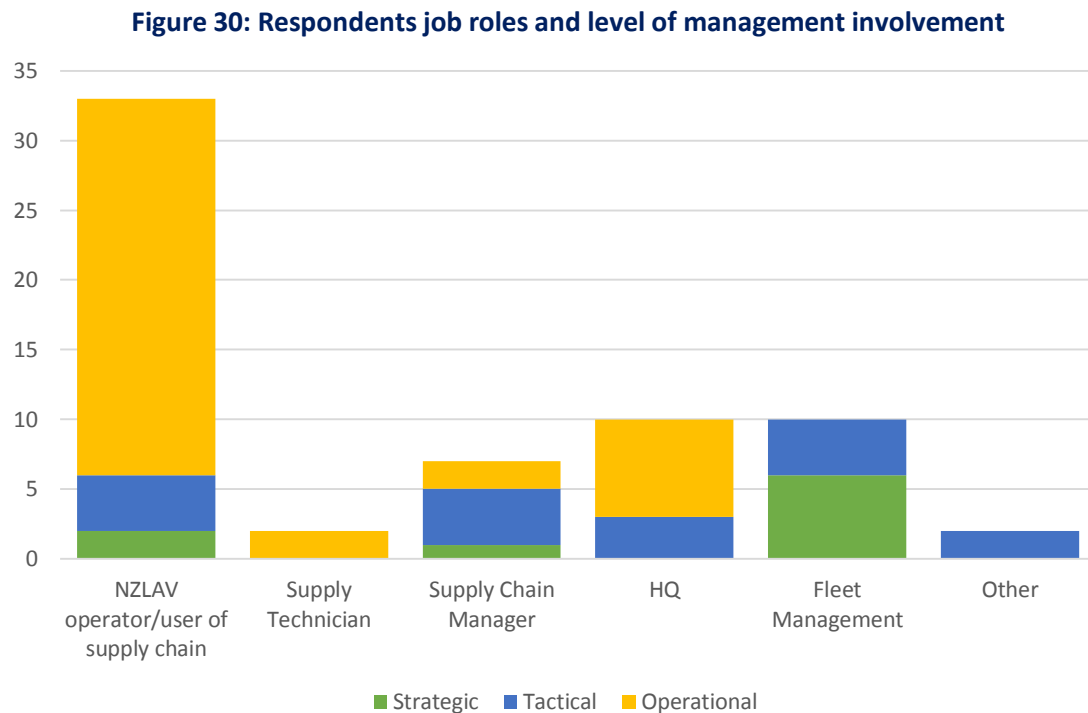
“I don’t know.”

“This survey should be aimed more towards the workshops or logistics pers [sic: personnel] that are involved with LAV. Being operators we don’t deal with the behind the scene stuff.”

When considering the range of personnel to factor in to the survey it was necessary to keep the scope wide enough to include the “customers” at the operational end of the chain, even if they are disinterested in the support system. Participants were asked to classify their involvement in the NZLAV supply chain against one of the following (where individuals had fulfilled more than one role, they were asked to indicate the role they had the longest experience in):

Title	Description
NZLAV Operator or User of the supply chain	NZLAV operators, which include crewman (drivers and vehicle commanders). Users of the NZLAV supply chain are the workshops tradespeople conducting the repairs on the NZLAV.
Supply Technician	Supply Technicians are those that manage and operate in the warehouses and stores sections.
Supply Chain Manager	Supply Chain Managers advise on and coordinate the purchasing, warehousing, distribution, and returns (reverse supply chain) of inventory and complete equipment to NZDF customers, included in this would be financial management and improvement activities.
Headquarters personnel	Headquarters personnel were considered to be a separate function of the supply chain because they direct activities that impact upon the supply chain but may not have expertise in SCM.
Fleet Management	Fleet Management are responsible for configuration management, testing and trials, obsolescence management, international procurement and repairs, and relationship management with OEM and suppliers.
Other	For individuals who felt they did not fit into one of the above groups

Figure 30 graphically shows the spread of respondents and how they classify themselves in regards to the NZLAV supply chain involvement and their management level.



The greatest number of survey responses came from the operational level NZLAV operator/User of the supply chain, which is a direct reflection of the population. It is difficult to quantify the population size of each job role as individuals progress through their careers they occupy a variety of roles. This may also explain the two responses who identify as strategic level operators. Annex F details the survey results for respondents' experience specific to the NZLAV supply chain and their broader experience within the NZDF.

Five year increments were used to indicated respondents' currency and, potentially, depth of experience specific to the NZLAV. The NZLAV was introduced into the NZ Army in 2003/2004; therefore respondents with more than 15 years' experience with NZLAV may be able to provide comment on original project procurement and design decisions. As not all pertinent supply chain experience and knowledge held by respondents will be constrained solely to NZLAV experience, survey participants were asked to identify their experience within the NZDF.

Fifty percent of respondents reported only having one to five years' experience within the NZLAV supply chain, which could indicate a reduced degree of confidence in the survey results. However this does not take into consideration respondents' wider NZDF supply chain experience. Eighty nine percent of respondents have had more than five years' experience within NZDF. This would improve confidence in survey responses and negate the need to weight survey responses.

Frequency data for participation in activity categories

Categories were selected based on the level of command and complexity of the supply chain. Activities conducted at the Unit level or below tend to be within the sphere of control or influence of those participating in the activity. The activity is likely to be within a simple supply chain environment; short supply lines, short activity, and inventory levels determined by those on the activity.

Activities conducted by Brigade and HQJFNZ generally involve more participants with limited resources that need to be prioritised; this can result in friction at the various levels which could manifest in dissatisfaction with the supply chain. The activity categories 'Unit level and below' and 'Brigade and HQJFNZ' tend to be low in supply and demand uncertainty.

Overseas exercises can involve a large number of participants and variety of nationalities, yet it is often easy to separate out supply chain issues that are the result of NZDF supply chain decisions. Complexity for this type of activity comes from the lengthened supply chain, obscurity of the exercise location, and the brevity of the exercise resulting in timeliness issues for delivering supplies. Overseas exercises tend to be low in supply uncertainty and high in demand uncertainty.

Overseas deployments is separate again from overseas exercises because, although they have the complexity of a lengthened supply chain and more obscurity around their end location, they tend to receive greater resources allocated to them and are in place for longer than an overseas exercise. Overseas deployments are frequently subject to high supply and demand uncertainties.

Survey Section 2 focused on NZ based activity categories; the questions asked were:

Number	Question
2.1a	Have you participated in activities involving NZLAV at the Unit level or below?
2.1b	Have you participated in activities involving NZLAV at the Brigade or HQJFNZ level?
2.2a	How many times have you participated in activities involving NZLAV at the Unit level or below?
2.2b	How many times have you participated in activities involving NZLAV at the Brigade or HQJFNZ level?

Section 3 focused on overseas activity categories; the questions asked were:

Number	Question
3.1a	Have you participated in activities involving NZLAV on overseas exercises?
3.1b	Have you participated in activities involving NZLAV on overseas deployments?
3.2a	How many times have you participated in activities involving NZLAV on overseas exercises?
3.2b	How many times have you participated in activities involving NZLAV on overseas deployments?

Additional survey data for these questions can be found at Annex F, Tables V – VII. Figure 31 shows the percentage of respondents’ participation across the activity categories. As respondents were allowed to indicate participation in multiple activities, the total responses for each activity category were divided by the total number of survey participants (64).

Figure 31: Responses for Activity Category Participation

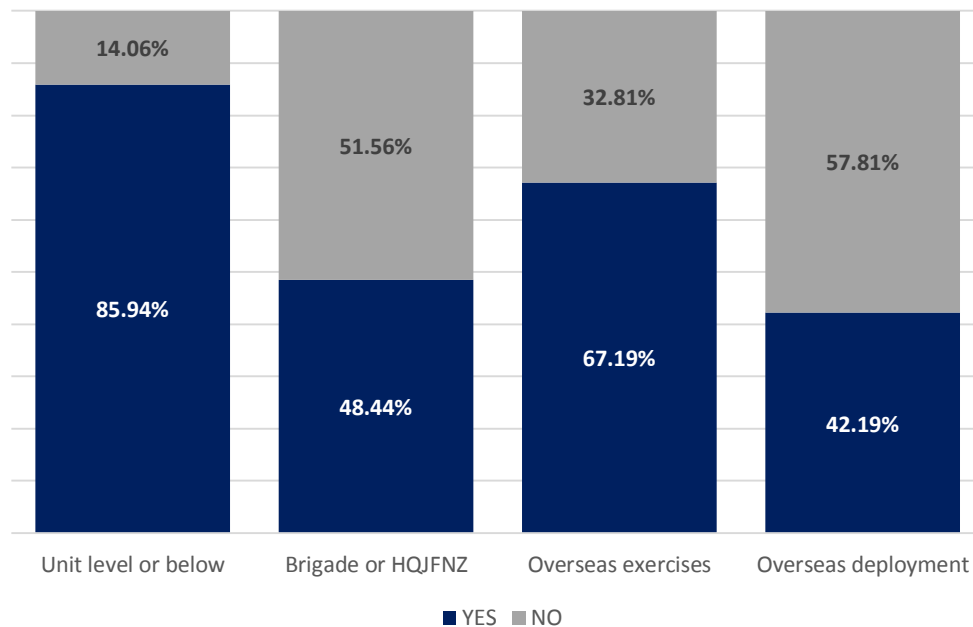


Figure 31 shows that 85% of respondents’ participated in activities at the Unit level or below, 40% more than overseas deployments, the activity category with the lowest participation by respondents. This could indicated greater confidence in Unit level or below results compared to the other categories. Unit level or below activities occur at a greater frequency but are shorter duration activities than all other categories; a reduced response rate is to be expected from the remaining three categories.

Survey questions 2.2 and 3.2 captured participation frequency by activity category, with respondents’ restricted to one selection per activity category. In order to compare the results across the categories frequency is measured as once, some or often; this method takes into account the frequency of activities that occur at each level annually. Each training year there is likely to be multiple Unit level or below activities, two Brigade or HQJFNZ activities, and one overseas exercise. There were only four rotations of NZLAV that deployed overseas, with very few individuals participating in more than one deployment.

The classification of “some” and “often” is detailed below:

Activity Category	Some	Often
Unit level or below	2-9 activities	10 or more activities
Brigade and HQJFNZ	2-4 activities	5 or more activities
Overseas exercises	2 activities	3 or more activities
Overseas deployments	2 activities	3 or more activities

Figure 32 displays the frequency of participation responses grouped by location; NZ and Overseas.

Figure 32: Frequency of Participation NZ and Overseas Activities

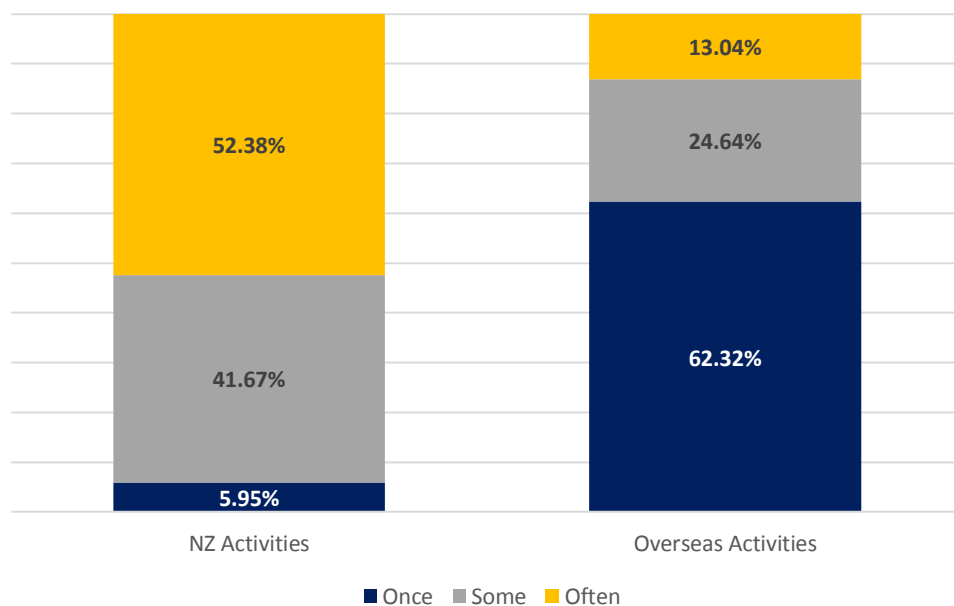


Figure 32 shows that 63% of respondents for overseas activity categories were basing their ratings on a single event, however for NZ activity categories 92% of respondents were basing their rating on multiple events. The results for the overseas activity categories are not nullified by these figures as the duration of a single event is sufficiently long enough for the rating to be considered valid.

Involvement in supply chain design

Prior to seeking responses on attitudes the survey obtained one further demographic question on the involvement in determining the structure of the NZLAV supply chain by activity category.

The survey questions were:

Number	Question
2.3a	Were you involved in determining the structure of the NZLAV supply chain, policies, or procedures at the Unit level or below?
2.3b	Were you involved in determining the structure of the NZLAV supply chain, policies, or procedures at the Brigade or HQFJNZ level?
3.3a	Were you involved in determining the structure of the NZLAV supply chain, policies, or procedures on overseas exercises?
3.3b	Were you involved in determining the structure of the NZLAV supply chain, policies, or procedures on overseas deployments?

Additional survey data for these questions can be found at Annex F, Table VIII and Figure III. When a NGO responds to a humanitarian disaster the NGO's supply chain policies do not change from previous disasters, however aspects of the supply chain plan and procedures may need to be adapted to suit the environment especially to overcome the often sighted 'last mile problem'. For example the distribution network will be specific to what is left available, inventory holding levels determined by need, and local purchasing or hiring of local staff dependant on the host nation government (if it still exists). Each time the NZDF plans an exercise or deployment whether in NZ or overseas there is a need to consider how the supply chain plan and procedures needs to be adapted to best suit the environment. Table 9 summarises respondents' involvement in designing the supply chain for the activity categories they participated on.

Table 9: Involvement in supply chain design responses

Number	Activity Category	Response	
		Yes	No
2.3a	Unit level or below	25.49%	74.51%
2.3b	Brigade and HQFJNZ	24.14%	75.86%
3.3a	Overseas exercises	21.95%	78.05%
3.3b	Overseas deployments	44.44%	55.56%
Average		29.01%	70.99%

Table 9 shows an average participation rate of 29% in designing the supply chain for the activities respondents were involved in. This lack of inclusion in designing the supply chain may impact on attitude ratings later in the survey.

Figure 33 displays the positive responses of being involved in the design of the NZLAV supply chain with the management level of the respective respondents.

Figure 33: Respondents involved in supply chain design with their management level

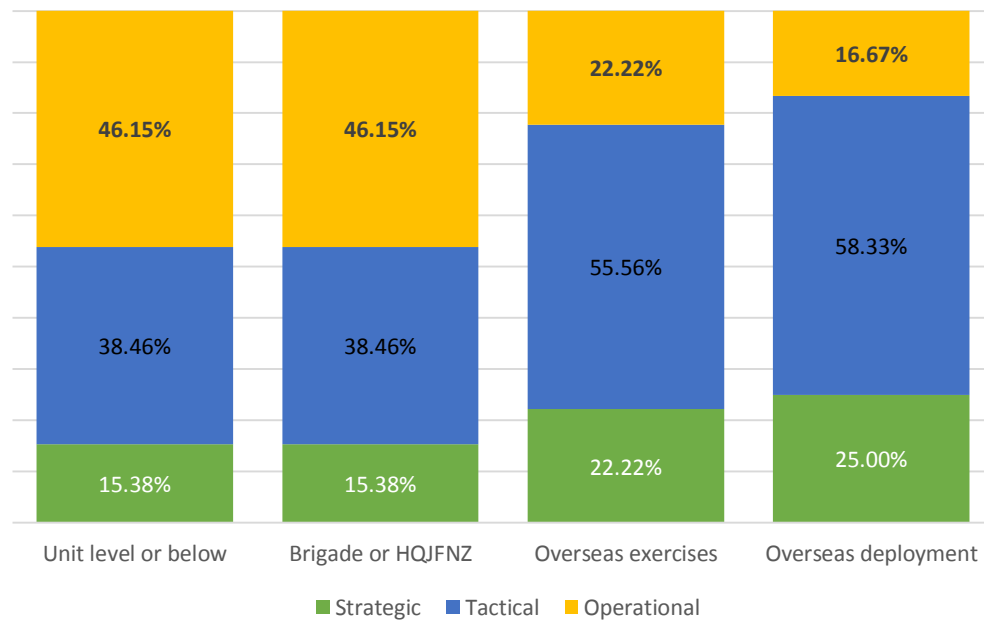


Figure 33 shows that strategic level respondents are more involved in designing overseas activities than NZ based activities. Overseas exercises occur biennially and there has only been one deployment (four rotations) of NZLAV overseas on operations and with the high frequency of staff turnover it is unlikely that a strategic level individual will be in the same position for more than three years. This raises the question about the experience level of those operating at the strategic level with respects to their knowledge of NZLAV supply chains; it is difficult to learn from mistakes when the opportunity to be involved is limited. The operational level of the supply chain, who has considerable exposure to the impacts of policy and procedural decisions, will only be involved in designing the supply chain for overseas activities on average 19% of the time.

4.3.2 Effectiveness and Efficiency Responses

The preceding sections of Chapter 4 have presented objective findings from the data collected; the findings presented in Section 4.3.3 and subsequent sections are based on survey respondents' subjective opinions. The questions regarding effectiveness and efficiency were intended to obtain data on respondents' attitude towards the appropriateness of the NZLAV supply chain within different environments. Responses were captured based on activity categories but can be interrogated further based on the management level that the respondents' operate at (strategic, tactical, or operational).

For the purposes of this survey effective is defined as maximising the achievement of outputs; right stuff, right place, right time, and right quality (Fugate, Mentzer, & Stank, 2010) (Anon, 2018). Efficient is defined as maximising the use of available resources to meet demands, with cost to

the organisation often being a key factor” (Fugate, Mentzer, & Stank, 2010) (Anon, 2018). Using publically available or unclassified documents it is not possible to assess the performance of the NZDF for its effectiveness or efficiency for each activity category. NZDF outputs are not specified in the terms of “provide [insert number] of NZLAV within [insert time] to respond to [insert deployment location, threat state, and situation]”. Rather the supply chain is required to be effective and efficient in response to all scenarios described in the Integrated Land Missions Model (New Zealand Army, 2017).

Effectiveness of the NZLAV supply chain

The survey questions regarding effectiveness were:

Number	Question
2.4a	The NZLAV supply chain, policies and procedures were <i>effective</i> in providing support for exercises at the Unit level or below?
2.4b	The NZLAV supply chain, policies and procedures were <i>effective</i> in providing support for exercises at the Brigade or HQFJNZ level?
3.4a	The NZLAV supply chain, policies and procedures were <i>effective</i> in providing support for overseas exercises?
3.4b	The NZLAV supply chain, policies and procedures were <i>effective</i> in providing support for exercises overseas deployments?

Unabridged survey data for these questions can be found at Annex F, Table IX and Figures IV - VII. Table 10 summarises the survey results for respondents’ views on the effectiveness of the NZDF supply chain, its policies, and its procedures were in providing support to NZLAV (see also Annex F, Table IX). Table 10 also compares how these results change when considering respondents’ involvement in designing the supply chain.

Table 10: Responses for effectiveness of the NZLAV supply chain

Attitude Rating		All responses		Not involved in the supply chain design		Involved in the supply chain design	
		Total	Strong views only	Total	Strong views only	Total	Strong views only
Strongly Agree/Agree	1-3	43	81.13%	35	87.50%	8	61.54%
Neutral/Ambivalent	4-7	92	NIL	70	NIL	22	NIL
Strongly Disagree/Disagree	8-10	10	18.87%	5	12.50%	5	38.46%

Table 10 shows that four out of five respondents hold strong positive views regarding the effectiveness of the NZLAV supply chain. The large number of respondents indicating a neutral or ambivalent attitude regarding effectiveness is potentially due to organisational conditioning of members to not challenge reported successes. It could also be due to respondents acknowledging

that resource quantities will limit desired effectiveness. Not being involved in the supply chain design did not negatively impact the strong views for effectiveness, with strong positive views increasing by six percent.

The results for strong views of those involved in the supply chain design paint a different picture. Table 10 showed that there was a 25 percent increase in negative ratings for those who were involved in designing the supply chain. Survey comments pertaining to effectiveness with respect to each activity category included positive and negative responses.

Unit level or below:

"Supply chains for unit level exercises tend to be more effective and efficient as the units can either control the supply chain or deploy with sufficient resources to sustain themselves for the duration of the exercise."

"Generally have the required repair parts available to get NZLAV back on the road"

Brigade and HQJFNZ:

"Supply chains for Bde level exercises can be more complex than unit exercises, however they tend to be effective and efficient because the Bde owns most of the elements on exercise and have been given adequate control of the supply chain. However HQJFNZ exercises (ex southern katipo) can be more constrained which can impact performance of the supply chain - and the desire to operate outside of the existing policies/procedures."

Overseas Exercises:

"First NZLAV deployment to ADF exercise was premature as support structure was not established and experienced, class 9 [sic: repair parts] stocks insufficient to support exercise and introduction into service training. No experience with scaling to support NZLAV exercise in Darwin."

"HQJFNZ currently restrict the ability to demand parts on the ground using SAP which adds delay to supply chain. Recent Exercise Talisman Sabre 17 where SAP demands were placed directly in SAP experienced minimal delay and received parts within 4 days."

"Due to the long lead times for parts from OEM local vendors were approached and could supply but were not able to be used due to contractual arrangements."

"On the exercise we were on, we had not planned for the conditions we would be operating in and consequently did not have enough parts for those that were consistently breaking. Then these needed to be rushed to us but still took so long as to make them effectively useless."

Overseas deployments:

"Management of the supply chain during operations is easier to achieve due to a more steady state of use being achieved."

"NZ had not previously deployed NZLAV on operational deployment, so the supply chain had not been tested in this way before. Some specific consumables and serialised parts were difficult to sustain due to the location/duration/employment of LAV on operations."

"... The ability to support from the other side of the world was a good experience; ensuring inventory levels were resilient as lead-time/delivery was a major constraint. Lots of lessons learn - lack of supply chain experience, lack of accountability, effective movement of equipment, support/guidance and or lack of from HQJFNZ."

"Was a long wait for replacement parts to arrive from NZ to Afghan [sic: Afghanistan]"

"Due to the slow moving parts the parts required were sometimes not held, this created issues as the veh [sic: vehicle] that required replacement parts were also required for patrol. This lead to a conversation/trying to get in touch with NZ to sign off the cannibalisation of a blown up vehicle."

"I was involved with the "up armoured" fit out in Bagram for the NZLAV. The equipment to conduct this task was poor which lead us to borrow equipment off the Canadian. This procedure was poor."

These comments would suggest that the NZLAV supply chain effectiveness is being negatively impacted by unwillingness to delegate or policies restricting the delegation of responsibility and accountability for the effectiveness of a deployed supply chain (overseas exercises or deployments) to the operational level. Although these comments were made in regards to overseas activity categories they are likely to be applicable to NZ exercises that are subjected to greater supply chain scrutiny, such as HQJFNZ activities. Inventory levels appear to be impacting on effectiveness ratings for overseas activity categories, though there appears to be an inconsistency in this area as there were both positive and negative comments.

Comments regarding effectiveness being negatively impacted by the lack of experience in the environment (deploying the NZLAV to Australia too early and the first NZLAV deployment to Afghanistan) are not surprising, but should be concerning to the NZDF. The NZDF is an expeditionary organisation, like NGO's responding to HADR events, the speed to which a supply chain can be deployed and become effective is critical to achieving success. These comments would also suggest that the NZLAV supply chain effectiveness is being positively enhanced by repeatedly deploying into different overseas locations to learn (or relearn) lessons and force changes to supply chain policies and procedures. Leveraging off advice from subject matter experts, original equipment manufacturers and technical advisors within NZDF, also enhances supply chain effectiveness.

Efficiency of the NZLAV supply chain

The survey questions regarding efficiency were:

Number	Question
2.5a	The NZLAV supply chain, policies and procedures were <i>EFFICIENT</i> in providing support for exercises at the Unit level or below?
2.5b	The NZLAV supply chain, policies and procedures were <i>EFFICIENT</i> in providing support for exercises at the Brigade or HQFJNZ level?
3.5a	The NZLAV supply chain, policies and procedures were <i>EFFICIENT</i> in providing support for overseas exercises?
3.5b	The NZLAV supply chain, policies and procedures were <i>EFFICIENT</i> in providing support for exercises overseas deployments?

Unabridged survey data for these questions can be found at Annex F, Table X and Figures VIII - XI. Table 11 summarises the survey results for respondents' views on the efficiency of the NZDF supply chain, its policies, and its procedures were in providing support to NZLAV (see also Annex F, Table X). Table 11 also compares how these results change when considering respondents' involvement in designing the supply chain.

Table 11: Responses for efficiency of the NZLAV supply chain

Attitude Rating		All responses		Not involved in the supply chain design		Involved in the supply chain design	
		Total	Strong views only	Total	Strong views only	Total	Strong views only
Strongly Agree/Agree	1-3	37	69.81%	29	72.50%	8	50.00%
Neutral/Ambivalent	4-7	92	NIL	71	NIL	21	NIL
Strongly Disagree/Disagree	8-10	19	30.19%	11	27.50%	8	50.00%

Table 11 shows that two thirds of respondents hold strong positive views regarding the efficiency of the NZLAV supply chain. A comparison between effectiveness and efficiency of strong negative views shows an increase from 19% to 30% for all responses, indicating a decrease in satisfaction for respondents' views towards the efficiency of the NZLAV supply chain. The number of neutral and ambivalent responses remains consistently high for similar reasons to effectiveness, however the increase in negative responses could be due to organisational conditioning of members at all levels to develop plans on use of resources and how they would achieve tasks. Not being involved in the supply chain design did not negatively impact the strong views for efficiency, with strong positive views increasing by three percent.

Table 11 shows a significant change in spread of strong views for efficiency of those that were involved in the supply chain design. The spread shifted from a positively favoured 70:30 result for

efficiency when considering all respondents to 50:50 when considering those who were involved in designing the supply chain. Survey comments pertaining to efficiency with respect to each activity category included positive and negative responses.

Unit level or below:

"Our supply chain is at a very good level we have a good stock of spares at rear base and at FOB [Forward Operating Base] to ensure fast efficient supply to our workshop personnel"

"The time it takes for parts from Trentham to reach Linton seems slow, considering that if the equipment needed to be out that day. Why can we not drive to Trentham to pick up our own parts on essential repairs?"

"... At the unit level, the biggest thing I noted was the holding of parts to support unit activities is not balanced ..."

Brigade and HQJFNZ:

"Supply process on brigade exercises is too slow. Seems to be a delay in processing paperwork and forwarding the information in a timely manner. Often the parts can arrive at ECH [sic: echelon, unit location] near the end of the exercise."

Overseas deployments:

"Management of the supply chain during operations is easier to achieve due to a more steady state of use being achieved."

"It seemed to work well and we got the parts we needed from the NSE [sic: National Support Element] to carry out repairs quickly."

Non-activity specific comments:

"Current model and policy provide an effective service level effectiveness, however is not necessarily efficient. Significant gains in NZLAV supply chain efficiency are likely to be unaffordable due to significant ties to the OEM and reduce flexibility."

"Imposed limits to supply chain staffing and class 9 [sic: repair parts] quantities unrelated to actual need"

"I think that LAV fleet do a great job in procuring parts in an ever demanding yet diminishing pot of gold. However it is very frustrating having to wait on major items or assemblies that are on back order from an overseas manufacturer...As the vehicles get older the supply chain becomes stretched with these high use items..."

"Just in time policy does not work due to long lead times. We should be able to purchase higher qty's [sic: quantities] of some spares which would save the amount of purchase orders raised. For example we should stock 24 months' worth of stock on certain items."

"I believe there remain significant efficiencies (in time, resources, manpower, finances) that could be anchored long term with closer alignment of our premier land fighting system (NZLAV) with our partners and allies. Commonality of support at any level across the LAVUNG [sic: Light Armoured Vehicle User Nation Group] would have alleviated at least a portion of the sustainment required for the Force Element and from an operator perspective would not have reduced the capability of the deployed force element ... As part of the original procurement of NZLAV a greater weighting on interoperability with other LAV user nations would have been beneficial and made sustainment of NZLAV (and all associated classes of supply) more straight forward and efficient."

These comments would suggest that the NZLAV supply chain efficiency is being negatively impacted by strategic and tactical policy and procedural restrictions reducing operational level authority to act. Retaining responsibility and accountability of the supply chain at the tactical level for the Brigade and HQJFNZ activities creates delays in decision making resulting in reduced output at the operational level. Other comments indicated that the need for efficiencies in the supply chain was a higher priority than effectiveness. The negative tone seemed to be about the lack of logic surrounding the imposed efficiencies; efficiency is appreciated as necessary but must be balanced by effectiveness. One respondent indicated that efficiency would have been improved by taking a systems thinking approach at the procurement stage, in particular commonality of capabilities with larger partner forces.

These comments would suggest that the NZLAV supply chain efficiency is being positively enhanced at the Unit level and below activity category by appropriately resourcing the Unit with inventory and authority to repair. Though this was countered by one individual who stated that Unit's inventory holdings were incorrect for their tasks and warehousing capacity. For the overseas deployments activity efficiency is positively enhanced by holding inventory sufficiently forward in the chain to support quick repairs. It was noted that efficiencies were created in the supply chain the longer it had been established for.

4.3.3 Changing the supply chain

Empowerment within the NZLAV supply chain

The question regarding whether individuals were empowered to make improvements to the NZLAV supply chain, its policies, or its procedures was intended to obtain data on respondents' ability to make authorised changes. Empowerment requires authority and power (Anon, 2017) to be given to individuals. Responses were captured based on activity categories but can be interrogated further based on the management level that the respondents' operate at (strategic, tactical, or operational).

The survey questions regarding empowerment were:

Number	Question
2.6a	I felt empowered to make improvements to the NZLAV supply chain, policies or procedures for exercises at the Unit level or below?
2.6b	I felt empowered to make improvements to the NZLAV supply chain, policies or procedures for exercises at the Brigade or HQFJNZ level?
3.6a	I felt empowered to make improvements to the NZLAV supply chain, policies or procedures for overseas exercises?
3.6b	I felt empowered to make improvements to the NZLAV supply chain, policies or procedures for overseas deployments?

Unabridged survey data for these questions can be found at Annex F, Table XI and Figures XII -XV. Table 12 summarises the survey results for respondents' views regarding their empowerment to make improvements to the NZDF supply chain, its policies, and its procedures that support NZLAV (see also Annex F, Table XI). Table 12 also compares how these results change when considering respondents' involvement in designing the supply chain.

Table 12: Responses for empowerment to improve the NZLAV supply chain

Attitude Rating		All responses		Not involved in the supply chain design		Involved in the supply chain design	
		Total	Strong views only	Total	Strong views only	Total	Strong views only
Strongly Agree/Agree	1-3	15	21.74%	9	15.79%	6	50.00%
Neutral/Ambivalent	4-7	67	NIL	42	NIL	25	NIL
Strongly Disagree/Disagree	8-10	54	78.26%	48	84.21%	6	50.00%

Table 12 shows that four out of five respondents hold strong negative views regarding their empowerment to make improvements to the NZLAV supply chain. The reduction in neutral or ambivalent survey responses, when compared to effectiveness and efficiency results, is potentially attributable to NZDF members being expected to lead change and take initiative.

Not being involved in the supply chain design negatively impacted the strong views for empowerment, with strong negative views increasing by six percent. This is contrary to effectiveness, efficiency, and desire to operate outside the prescribed system results.

Table 12 further shows a significant change in spread of strong views for empowerment of those that were involved in the supply chain design. The spread shifted from a negatively favoured 84:16 result when considering all respondents to 50:50 when considering those who were involved in designing the supply chain.

Survey comments pertaining to empowerment provide some context for the dissatisfaction with this aspect of the supply chain.

Unit level or below:

"While conducting exercises at 1RNZIR during initial motorisation ... significant freedoms were provided to me as echelon operations officer to in-stock, design and execute tactical NZLAV supply chain. This was reliant on good comms [sic: communications] with fleet management and 2nd line wksp [sic: workshop] for class 9 [sic: repair parts]"

"We changed the processes a number of times during my involvement therefore difficult to provide a view on questions above"

"From my perspective the support that is provided by the NZLAV supply chain from the Suppliers - Warehouses - Units - Exercise has been workable and efficient. This comes down to building good relationships with all stakeholders, proper planning, provisioning and ensuring we provide a diverse range of spares or the ability to source these quickly to support the customer, repair pre, during and post exercise. Being surrounded by people who have sound technical experience, who can think outside the box and provide alternative solutions makes for a strong team."

Overseas Exercise:

"At that stage I did not have the rank or experience to effectively adopt change."

"Sometimes at the operational [sic] level you have the requisite knowledge to source local vendors that meet all requirements however cannot use due to contractual arrangements. This affects the agility of the supply chain. Carrying appropriate amount of spares needed is always limited by support veh [sic: vehicles]/containers allowed."

Non-activity specific comments:

"Lessons learnt need to be captured and processes/policies/plans changed/adapted for future activities. NZDF needs to be a learning organisation. We seem to rest a lot of info about NZLAV operations with individuals rather than consolidating the info for the organisational benefit."

"A standardised supply chain should be applied to ALL exercises. This standardised supply chain should also be taught on officer and soldier courses [sic]..."

These comments would suggest that the NZLAV supply chain empowerment is impeded by policies and the strict hierarchal organisational management design limiting the value individuals have in their own ideas and preventing changes being suggested or implemented. These comments would also suggest that the NZLAV supply chain empowerment is being positively enhanced by good relationship management which enables alternative solutions to be implemented with the correct authorities. There were no comments specific to empowerment for the Brigade and HQJFNZ or Overseas Deployment activity categories. There may be comments from the next survey section on the desire to operate outside of the prescribed NZLAV supply chain that may provide context to the ratings for these activity categories.

Operating outside the prescribed supply chain for the NZLAV

The question regarding whether survey participants needed or desired to operate outside of the prescribed NZLAV supply chain, its policies, or its procedures was intended to obtain data on respondents' attitude on unauthorised changes. Unlike empowerment, this question implies hurdles or challenges preventing the respondent from making authorised changes. Responses were captured based on activity categories but can be interrogated further based on the management level that the respondents' operate at (strategic, tactical, or operational).

The survey questions were:

Number	Question
2.7a	I did not need to (or wish to) operate outside of the prescribed NZLAV supply chain, policies or procedures for exercises at the Unit level or below?
2.7b	I did not need to (or wish to) operate outside of the prescribed NZLAV supply chain, policies or procedures for exercises at the Brigade or HQFJNZ level?
3.7a	I did not need to (or wish to) operate outside of the prescribed NZLAV supply chain, policies or procedures for overseas exercises?
3.7b	I did not need to (or wish to) operate outside of the prescribed NZLAV supply chain, policies or procedures for overseas deployments?

Unabridged survey data for these questions can be found at Annex F, Table XII and Figures XVI - XIX. Table 13 summarises the survey results for respondents' views regarding their desire to operate outside the prescribed NZDF supply chain, its policies, and its procedures that support NZLAV (see also Annex F, Table XII). Table 13 also compares how these results change when considering respondents' involvement in designing the supply chain.

Table 13: Responses for the desire to operate outside the prescribed NZLAV supply chain

Attitude Rating		All responses		Not involved in the supply chain design		Involved in the supply chain design	
		Total	Strong views only	Total	Strong views only	Total	Strong views only
Strongly Agree/Agree	1-3	50	66.67%	41	71.93%	9	50.00%
Neutral/Ambivalent	4-7	61	NIL	44	NIL	17	NIL
Strongly Disagree/Disagree	8-10	25	33.33%	16	28.07%	9	50.00%

Table 13 shows that two thirds of respondents hold strong positive views for this section, indicating that they did not need to or did not desire to operate outside the prescribed system. Comparing these survey results with empowerment results indicates that although personnel were dissatisfied with their level of empowerment they were not inclined to operate outside the

prescribe system. This in itself is potentially an indication of the hierarchal structure of the NZDF, where responsibility and authority is held at higher levels and strictly enforced.

Table 13 shows a change in spread of strong views for this section of those that were involved in the supply chain design. As with the results for efficiency and empowerment, the spread for this section of strong views is also 50:50 for those involved in designing the supply chain.

Tables 10 – 13 show that 49% - 68% of respondents' who were involved in the supply chain design were neutral or ambivalent in their ratings for effectiveness, efficiency, empowerment, and the desire to operate outside the system. This trend suggests that there are aspects of NZDF supply chain policy constraining supply chain design for the activity categories. Where individuals involved in the supply chain design cannot change policy constraints to enable a better design, they may return neutral or ambivalent views; empowered by being involved in the design of the supply chain, but not empowered enough to change policy, therefore returning a neutral or ambivalent response for empowerment.

Survey comments pertaining to this section provide some context to the ratings.

Unit level or below:

"Often required to ring ASM or RPS to organise LRU/parts to be delivered out to exercises"

"Due to the amount of repairs required some occasions of cannibalisation of goods were required to be done manly with repairable items e.g. CDU/GDU this was due to delays in receiving repaired items back and limited stock held."

Unit level or below, and Brigade and HQJFNZ:

"often had to resort to using outside methods (cell phone etc) to source parts due to delays with the supply system"

Brigade and HQJFNZ:

"Inadequate planning resulted in the troops needing to go outside of the supporting units means in order to meet demands or requirements."

"On the big exercises, inadequate planning and lack of proper appreciation of the ground resulted in not enough supplies to the troops so outside sources were used to rectify issues."

Overseas Exercise:

"Poor planning lead to us having to get a credit card to get parts via civ trade on TS17"

Non-activity specific comments

"The 'Bro Net' is alive and well. It is a blight on the NZDF supply chain that the command elements encourage rather than discourage."

These comments would suggest that there is a requirement for the operational level to operate outside of the prescribed supply system for the purpose of ensuring NZLAV availability remains high. With higher level combat commanders supporting such behaviour or placing pressure on the supply chain to perform to a level than what it is resourced for.

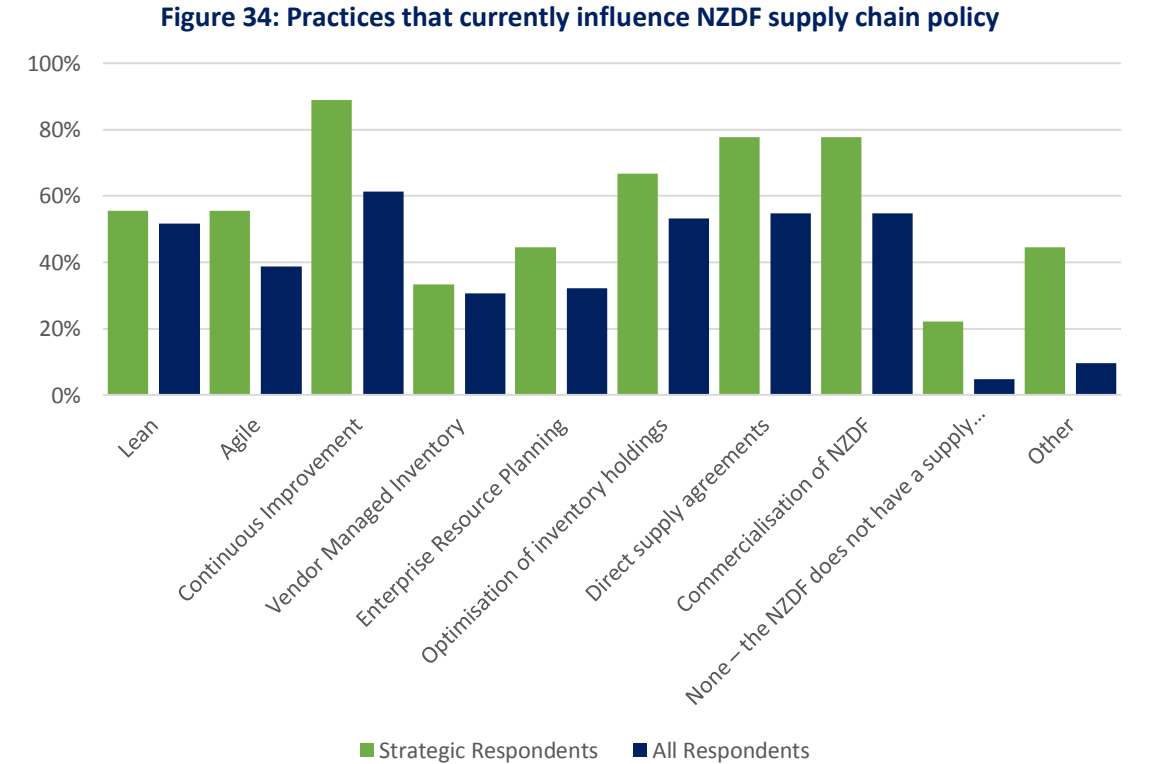
4.3.4 NZDF supply chain policy

Theories and practices that influence NZDF supply chain policy

The questions pertaining to NZDF supply chain policy were intended to obtain data on respondents’ views on matters that influence NZLAV supply chain design. The survey question discussed in this section is:

Number	Question
4.1	What supply chain theories, ideas, or best business practices currently influence NZDF supply chain policy? (Multiple responses allowed)

Unabridged survey data for this question can be found at Annex F, Table XIII and Figure XX. The terms selected for the question were terms used by the NZDF in documents and conferences where improvements to NZDF supply chain have been discussed. Respondents were allowed to select multiple answers if they perceived more than one theory, idea or practice had influence on supply chain policy. The responses regarding influences on supply chain policy can be interrogated based on the management level of the respondents; Figure 34 shows these results graphically.



When considering all respondents Figure 34 shows only a six percent gap between the top three most rated practices that influence NZDF supply chain policy and nine percent gap between the top five. This could indicate an improved communications plan is needed in order to clarify what direction the NZDF supply chain is taking regarding its supply chain policy.

Alternatively it could indicate that the supply chain is influenced by multiple theories or practices. It would be appropriate to review these influences to ensure they are not at cross purposes. When considering only strategic level respondents, the most rated theory influencing NZDF supply chain policy increases 28%. However there is still only an 11% gap between the top three most rated practices for strategic level respondents. This would suggest that there is greater clarity at the strategic level on what drives policy, but there is still potential for confusion regarding the interactions of the top three drivers. There are advantages to direct supply agreements and commercialisation, however a continuous improvement activity should be able to overturn the application of such policy where it is appropriate to; for example when commercialisation or direct supply agreements are negatively affecting the NZDF achieving its goal.

4.3.5 Levels of decision making

This section of the survey was intended to obtain data on how respondents' viewed the current weight of responsibility for supply chain decisions and how this could be distributed in the future. Multiple responses were allowed in this section and the results can be interrogated based on the respondents' own management level within the organisation. The survey questions discussed in this section are:

Number	Question
4.2	Please tick what decisions are made or responsibilities currently exist at the following levels of command? (Multiple responses allowed)
4.3	Please tick what decisions or responsibilities <i>should be delegated</i> to the following levels of command? (Multiple responses allowed)

Unabridged survey data for these questions can be found at Annex F, Tables XIV – XVI and Figures XXI – XXVI. Table 14 shows how literature (Lambert & Cooper, 2000) (Schmidt & Wilhelm, 2000) (Lee, 2002) (Fox, Barbuceanu, & Teigen, 2000) (Hutchin, 2002) allocates the 18 supply chain decisions and responsibilities used in the survey.

Table 14: Literature allocation of authority for supply chain decisions or responsibilities

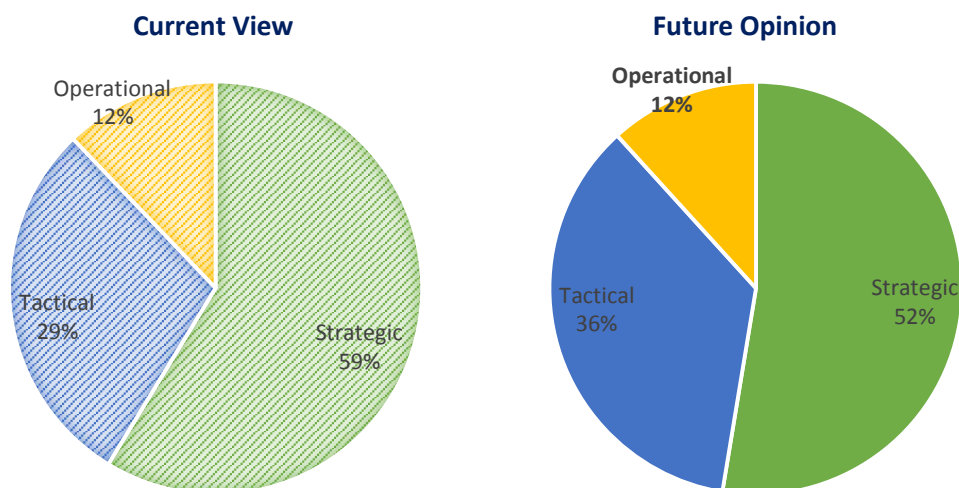
Supply Chain Decision		Literature Recommendation
1	Establish policy	Strategic
2	Develops international agreements (Implementing Agreement, Memorandum of Understanding)	Strategic
3	Determine facility locations and capacities	Strategic
4	Determine the supply network	Strategic
5	Allocate funding and resources to meet need	Strategic
6	Establish procedures	Tactical
7	Determine inventory levels	Tactical
8	Selects prime vendors	Tactical
9	Establish procedures for procuring through international agreements	Tactical
10	Determine whether sole source, multi-source, or commercial off the shelf	Tactical
11	Determine lead time requirements	Tactical
12	Establish contracts with providers	Tactical
13	Determine how and when items move through the chain	Operational
14	Determine what is classed as 1 st , 2 nd , 3 rd , 4 th line task	Tactical
15	Determine local purchase constraints	Operational
16	Refine the plan to meet changing circumstances	Operational
17	On time delivery of demands to customers	Operational
18	Coordinate of the distribution network to respond to customers' demands	Operational

Table 14 indicates that the strategic level should hold authority for 28% of supply chain decisions, the tactical level 44%, and the operational level the remaining 28%. This does not preclude management levels from being involved those areas of the supply chain outside of their allocated authority nor should it be applied religiously to the NZDF without due consideration towards specific organisational needs. The purpose of Table 14 is to show that there are supply chain decisions or responsibilities that could be considered for delegation in order to enable higher management levels to focus on longer term business direction. This approach is reflected in NZDF policy which requires responsibility and authority to be delegated as far as practical.

Strategic level views of NZDF supply chain decisions

Figure 35 summarises graphically how survey respondents from the strategic management level view the current allocation of authority for NZDF supply chain decisions and responsibilities and how the balance of these decisions or responsibilities should change in the future. Annex F tabulates survey responses in greater detail.

Figure 35: Strategic respondents' allocation of supply chain decisions or responsibilities



Strategic responses on strategic level responsibilities: Figure 35 indicates that respondents from strategic management level believe the strategic level currently controls the majority of NZDF supply chain decisions and responsibilities. Future opinion is that a slight reduction in recommended, however the majority of responsibility should be retained with the strategic level.

Strategic responses on tactical level responsibilities: Figure 35 indicates that respondents' from strategic management level believe the tactical level remain involved in all areas of the supply chain and should be given greater authority for the NZDF supply chain decisions.

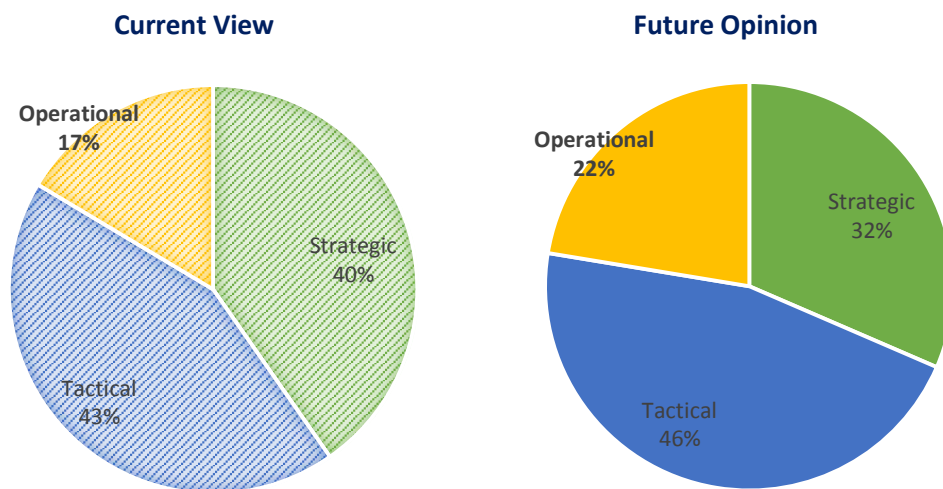
Strategic responses on operational level responsibilities: Figure 35 indicates that respondents' from strategic management level believe the operational level's total overall involvement should remain the same, but there needs to be changes in which areas they should be involved in. Strategic level respondents indicated that there were some areas which the operational level should be excluded from having any involvement. There were no areas where strategic level respondents indicated that the authority for supply chain decisions should be transferred to the operational level in the future. This approach would directly contravene NZDF policy on delegating responsibility and authority, create an unnecessary burden on the tactical and strategic levels, and

potentially result in the operational level disengaging from the supply chain and any subsequent performance improvement programmes.

Tactical level views of NZDF supply chain decisions

Figure 36 summarises graphically how survey respondents from the tactical management level view the current allocation of authority for NZDF supply chain decisions and responsibilities and how the balance of these decisions or responsibilities should change in the future. Annex F tabulates survey responses in greater detail.

Figure 36: Tactical respondents' allocation of supply chain decisions or responsibilities



Tactical responses on strategic level responsibilities: Figure 36 indicates that respondents from tactical management level believe the strategic level has the responsibility for more NZDF supply chain decisions than is necessary.

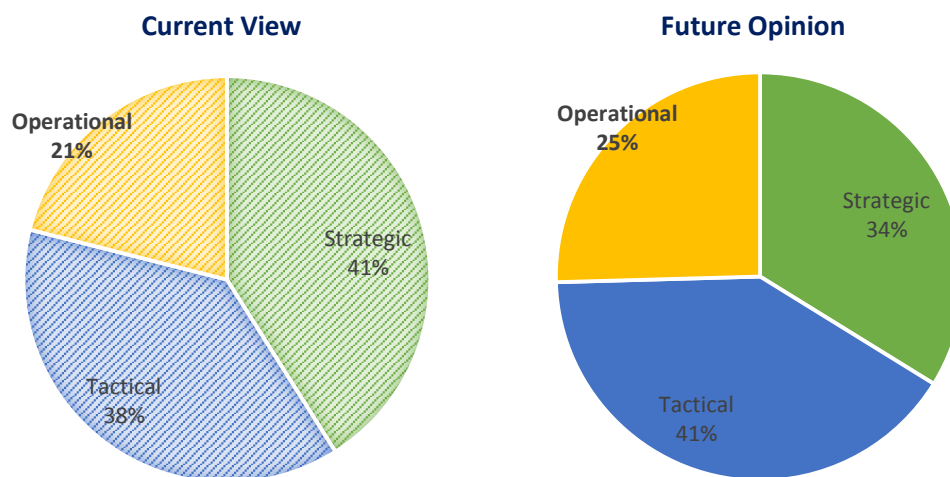
Tactical responses on tactical level responsibilities: Figure 36 indicates that respondents from tactical management level believe the tactical level should be responsible for more NZDF supply chain decisions than the currently are.

Tactical responses on operational level responsibilities: Figure 36 indicates that respondents' from tactical management level believe the operational level overall balance of responsibilities should increase. Tactical level results support the strategic level results regarding exclusion of the operational level from certain areas of supply chain decisions and not transferring any authority for supply chain decisions to the operational level.

Operational level views of NZDF supply chain decisions

Figure 37 summarises graphically how survey respondents from the operational management level view the current allocation of authority for NZDF supply chain decisions and responsibilities and how the balance of these decisions or responsibilities should change in the future. Annex F tabulates survey responses in greater detail.

Figure 37: Operational respondents' allocation of supply chain decisions or responsibilities



Operational responses on strategic level responsibilities: Figure 37 indicates that respondents from operational management level believe the strategic level has authority for more NZDF supply chain decisions than is necessary. This supports the recommendations of tactical level respondents.

Operational responses on tactical level responsibilities: Figure 37 indicates that respondents from operational management level believe the tactical level should be responsible for more NZDF supply chain decisions than they currently are. This is similar to the recommendations of tactical level respondents.

Operational responses on operational level responsibilities: Figure 37 indicates that respondents from operational management level believe the operational level should be more involved in the NZDF supply chain than it currently is. This differs considerably to strategic and tactical level respondents, who advocated for reduction of involvement in some areas and excluding from others. Operational level respondents indicated that the operational level should be given authority for some supply chain decisions, which contradicts the recommendations of strategic and tactical level respondents.

Reallocation of NZDF supply chain decisions

Table 14 above demonstrates literature's suggestions for the allocation of supply chain decisions. Figures 35 – 37 show that respondents' from the three management levels agree that a reallocation of supply chain decisions is recommended. A 5 – 10% reduction in strategic control of the supply was recommended, the control was transferred to and largely shared evenly between tactical and operational levels. Strategic level respondents differed in their reallocation, recommending control only be transferred to the tactical level. Table 15 (below) compares the survey results for re-allocating responsibility for supply chain decisions with literature's recommendations in Table 14.

Table 15: Re-allocation of authority for supply chain decisions or responsibilities

Supply Chain Decision		Survey Recommendation (Future Opinion)	Literature Comparison
1	Establish policy	Strategic – 58.90%	Same
2	Develops international agreements (Implementing Agreement, Memorandum of Understanding)	Strategic – 65.67%	Same
3	Determine facility locations and capacities	Tactical – 44.57%	Under
4	Determine the supply network	Tactical – 53.16%	Under
5	Allocate funding and resources to meet need	Strategic – 55.00%	Same
6	Establish procedures	Tactical – 40.00%	Same
7	Determine inventory levels	Strategic – 40.45%	Under
8	Selects prime vendors	Strategic – 48.10%	Over
9	Establish procedures for procuring through international agreements	Strategic – 54.93%	Over
10	Determine whether sole source, multi-source, or commercial off the shelf	Strategic – 46.15% Tactical – 44.87%	Shared
11	Determine lead time requirements	Tactical – 49.43%	Same
12	Establish contracts with providers	Strategic – 45.45%	Over
13	Determine how and when items move through the chain	Tactical – 47.06%	Over
14	Determine what is classed as 1 st , 2 nd , 3 rd , 4 th line task	Tactical – 48.31%	Same
15	Determine local purchase constraints	Tactical – 49.68%	Over
16	Refine the plan to meet changing circumstances	Operational – 38.89% Tactical – 37.04%	Shared
17	On time delivery of demands to customers	Tactical – 38.20% Operational – 33.71%	Shared
18	Coordinate of the distribution network to respond to customers' demands	Tactical – 43.16%	Over

Table 15 shows that 12 of the survey's allocation for supply chain decisions do not match literature's recommendations; only three supply chain decisions returning a survey result level lower than literature, however this was only to the tactical level. None of the five areas that literature recommends should be allocated to the operational level were supported by the survey

results, instead these areas remained allocated to the tactical level or shared responsibility between tactical and operational levels.

Figures 35 – 37 and Table 15 indicate that there is a moderate trend to shift responsibility for supply chain decisions from the strategic level to subordinate levels, however there is a larger trend to reduce the strategic level's overall involvement. These trends are further explained in Figure 38, which compares survey results for specific supply chain decisions for each management level. The percentages used in these comparisons are provided in Annex F for all 18 decisions.

Figure 38: Comparison of Current and Future Allocation of Strategic Decisions

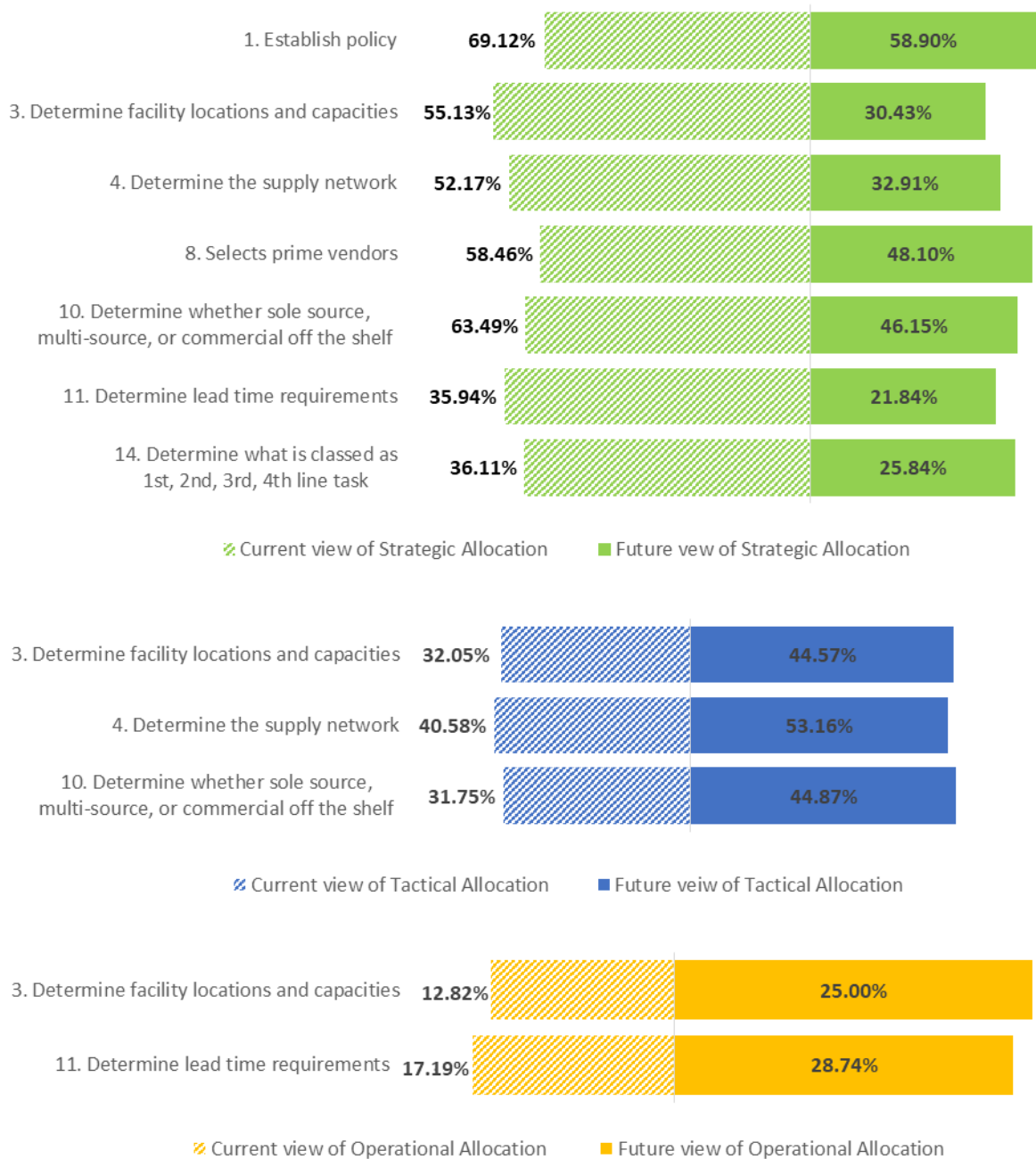


Figure 38 compares total percentages of all respondents' for current views and future opinions on those supply chain decisions where the allocation changed by more than ten percent, for each of the management levels. Figure 38 shows that the strategic level's future allocation of involvement for these seven areas all reduced, including in one area (1. Establishing policy) which according to literature is a strategic responsibility. The remaining six areas where the strategic level's involvement should be reduced according to survey results were not, according to literature, strategic responsibilities anyway.

Figure 38 further shows the three areas where the tactical level's future allocation changed by more than ten percent. These three areas are already allocated to the tactical level according to literature, however for one area (10. Determine whether sole source, multi-source, or commercial off the shelf) the responsibility remains shared between the strategic and tactical levels.

Figure 38 also shows the two areas where the operational level's future allocation changed by more than ten percent. Both of these areas are tactical level responsibilities according to literature and remain so according to survey results, however operational level's involvement doubled for 3. Determining facility locations and capacities.

4.3.6 Delegating and listening to subordinate levels

The questions on management were intended to obtain data on respondents' perceptions of higher levels of management's mechanisms for control of the supply chain. Nominal data was obtained for each question; however this data can be interrogated further based on the management level that the respondents operate at and length of service within the NZDF.

The survey questions discussed in this section are:

Number	Question
4.4	Does the NZDF delegate Responsibility, Accountability, and/or Authority to act with respects to NZLAV supply chains to the following levels? Strategic to Tactical and Tactical to Operational ¹⁷
4.5	Do strategic and tactical level commanders pay adequate attention to advice provided by operational commanders and LAV operators?

Unabridged survey data for these questions can be found at Annex F, Tables XVII - XXI and Figures XXVII - XXVIII.

¹⁷ Wording of these questions have been altered to reflect commercial business use of strategic, tactical and operational terminology. The survey at Annexes E and F use the military terminology.

Responsibility, Accountability, and Authority

For the purposes of the survey responsibility, accountability, and authority is defined as below:

Responsibility is the obligation to perform a task, function, or activity assigned to an appropriate standard. (Bivins, 2006)

Accountability is the assurance that an individual or an organisation will be evaluated on their performance of the task, function, or activity assigned, and rewarded or disciplined based on the evaluation. (Bovens, 2007) (accountability, 2018)

Authority is the right or power assigned in order to achieve the task, function or activity. This includes the right or power to change procedures if necessary to achieve the task, function or activity. (Certo & Certo, 2009)

NZDF policy states that accountability follows delegated authority (New Zealand Defence Force, 2014) therefore survey results for accountability should be tied to or match authority results. Table 16 summarises the survey results for the delegation of responsibility, accountability and authority as individual criteria.

Table 16: Delegating of Responsibility, Accountability, and Authority in NZLAV supply chain

Management Level	Responsibility	Accountability	Authority
Strategic to Tactical	70.91%	70.91%	58.18%
Tactical to Operational	70.91%	63.64%	52.73%

Table 16 shows that, on average, responsibility, accountability, and authority are delegated from the strategic to the tactical level 67% of the time. This drops by five percent to a 62% average for delegation from the tactical to operational level. These results are for the delegation of individual criteria, however to be effective responsibility must be delegated with the appropriate amount of authority. Where Table 16 (above) focuses on the results as individual criteria, Table 17 (below) summarises those survey respondents that saw two factors delegated together.

Table 17: Linkages between Responsibility, Accountability, and/or Authority

Management Level	Responsibility with Accountability	Responsibility with Authority	Accountability with Authority
Strategic to Tactical	52.73%	41.82%	41.82%
Tactical to Operational	54.55%	36.36%	30.91%

Table 17 shows that, on average, only 39% respondents believe responsibility is delegated with the appropriate authority; this suggests that the individual responsible for an NZDF supply chain task may not be the same individual with the authority to achieve the task.

Table 17 shows that there is a stronger perceived relationship between responsibility and accountability than responsibility and authority at both levels. This could explain why the survey returned negative results regarding empowerment simultaneously with a lack of need or willingness to operate outside of the prescribed system. An organisation that places greater emphasis on holding personal accountable than on delegating appropriate authority for tasks is likely to generate an obedient workforce that follows policy and procedures but one that is not inclined to seek out improvement activities or make timely decisions that best benefit the organisation.

Listening to subordinates in the organisation

Retaining authority for NZDF supply chain decisions at a higher than recommended level as survey results in Section 4.4.7 indicate would be understandable if strategic and tactical levels paid adequate attention to the advice of operational commanders and LAV operators. Table 18 summarises survey responses regarding whether superior commanders listen to operational advice. These results are shown by the management level of the respondents.

Table 18: Survey responses on whether superior commanders listen

Number	Respondents management level	Response	
		Yes	No
4.5	Strategic level	4	5
	Tactical level	5	10
	Operational respondents	7	24
Total		16	39

Table 18 (above) shows that an average of 71% of respondents believed that superior commanders do not pay adequate attention to the advice of the operational level. To check that these results were not unduly influenced by respondents' position within the management, respondents' experience within the NZDF based on time and frequency of participation in activities was also considered. Table 19 (below) shows the positive and negative responses in relation to their respective lengths of service within the NZDF.

Table 19: Responses on if superior commanders listen based on NZDF experience

Amount of experience		Response	
		Yes	No
1-5 years	Limited experience	0	6
6-20 years	Recent experience	5	25
21+ years	Considerable experience	11	8
Total		16	39

Table 20 shows the positive and negative responses in relation to their respective frequency of participation on activities.

Table 20: Responses on if superior commanders listen based on activity frequency

Frequency of activities	Response	
	Yes	No
Once	2	3
Repeated participation in an activity category	14	36
Total	16	39

Excluding those with limited experience Table 19 shows that an average of 60 % respondents believed that superior commanders do not pay adequate attention to the advice of the operational level. Excluding those whose participation in activities was limited Table 20 shows the average of responses is 65%. This is a reduction of 11% and 6% respectively compared to the results in Table 18. To provide context to this negative survey result the survey comments were reviewed to provide context to the question on whether higher level commanders listened to advice from subordinates. There was one positive comment and numerous comments that had a negative tone or suggested areas for improvement.

Positive comment:

"Operational [sic] commanders and LAV operators have opportunities to pass on any concerns."

Negative comments:

"We sometimes take this too far. At the strategic and tactical [sic] level staff are generally well aware of the needs of a LAV unit. The same cannot be said of a LAV unit understanding strategic and tactical [sic] imperatives."

"Impractical suggestions by operational [sic] commanders and LAV operators."

"...it is my experience that the strategic and tactical [sic] commanders hear what the FE [Force Elements] have to say and then carry on with their own agenda..."

"Noting due to our Joint nature at relatively low levels compared to our partners and allies there continues to be a need to educate our operational [sic] and strategic decision makers on the differences between AFV and PMV/MRAP [sic: Armoured Fighting Vehicle and Protected Mobility Vehicle/Mine Resistant Ambush Protection] and the supply chain implications involved with a mixed fleet."

"Exercise personnel on occasions would not listen to "best advice" offered by the NZLAV Fleet management at times taking the position that they knew best."

"Regularly had to inform the boss on the correct policy and procedures for providing support to the LAV. This information wasn't always liked/appreciated as it created what the commanders perceive as unnecessary "loggie" delays."

"The supply chain [sic: in reference to Brigade and HQJFNZ activity category] is often disrupted or hindered by a variety of factors (personalities, ignorance, unwillingness to take expert advice, unwillingness to utilise fast freight modes etc)...Unfortunately the user unit lacks staff with sufficient experience and 'voice' to influence the supply chain."

"Commanders at all levels should listen to the SME's. For instance prior to deploying on Ex Talisman Sabre ... I impressed upon the exercise commander [sic] the importance of taking enough tyres and wheel assemblies... the commander [sic] disagreed and chose to ignore my advice (which was a lesson from previous overseas ex's). Mid way through the ex 20 new tyres were flown into us from NZ."

"Strategic commanders apply theories to the organisation assuming it will result in significant savings - but they don't appear to assess the outcome to determine if these savings are actually realised. They are quick to disregard the views of operators on how strategic theories may not generate "savings" in time/people/money. "

"NZLAV was new to the AO [sic: area of operation], ammunition was one of the biggest issues. Does it come from US/Canada/AS/NZ etc.? Too many people at various levels getting involved, clear liaison should have been conducted at a higher level..."

"Not involved in HQJFNZ deployment planning until key support decisions had already been made. HQJFNZ attempting to impose non-standard supply processes to make their job easier."

"Poor understanding of processes and lead times by operational [sic] level have resulted in insufficient warning for R +O/purchases. The need for deployable SAP is consistently put in too hard box."

"Most ideas/points are discussed but then no follow up action from unit level. When individuals discuss their concerns with WKSP/LMGI personnel we find out that it is either "hamstrung" at unit level or "that's the first thing they have heard of it"."

"When asked on things that need to be improved it goes up the chain of command but never comes back down or they change things in a way that does not fix or solve a solution and tradesman/operator ALWAYS! End up saying "told you so"."

"the process of passing on of advice is a problem - it is not easy and feedback doesn't seem to happen much."

These comments would suggest that there is paths for the operational level to communicate with the tactical and strategic management levels regarding improvements to the NZLAV supply chain, however communications could be improved by enhancing the feedback loop to all operators. Additionally capturing lessons learnt and having these accessible for future planners at all management levels could improve ratings for this section.

There were two comments that discussed the lack of value to be gained from listening to those at the bottom of the operational level. Though these individuals are effectively "customers" of the NZLAV supply chain that has been designed the perception was that these "customers" did not understand the strategic or tactical level requirements. One theme that came through strongly in a number of comments was that the strategic and tactical management level's priorities were of

greater importance than the issue that the operational level was raising, and although they listened to subordinates they dismissed the advice. There is potential that this particular theme is linked to poor communication techniques and systems or even a lack of coherent NZDF supply chain policy.

There were a few comments regarding personnel at the tactical and strategic level not being held accountable for their decisions – particularly where advice was given by the operational level and failure to heed that advice negatively impacted on the supply chain. There were also a few comments that discussed negative supply chain performance resulting from a lack of clarity around supply chain responsibilities and authorities.

4.4 Major findings and insights of data analysis

Data for this research was obtained from an analysis of actual equipment availability and survey responses from a of sample population involved in NZLAV supply chain.

4.4.1 NZLAV supply chain performance based on SAP data

SAP data on equipment availability status has been captured for the duration of the NZLAV's service life, for the purposes of this research it has been capped at 2016. The data in Figure 25 shows that the actual availability, provided an appropriate notice to deploy is given by the NZ Government, exceeds the minimum required availability of 80% on all but four years. The data also shows that over the period that the NZLAV were deployed to Afghanistan (2011 – 2013) the fleet was able to be maintained to above the minimum required level. It is possible from this to conclude that the NZLAV supply chain is effective but with decreasing MTBF across the fleet (Figure 27) it has cost an increasing amount to sustain this level of effectiveness (Figure 28). It is not possible to make a conclusion from the data analysed about the efficiency of the NZLAV supply chain. However it can be stated that efficiency drivers, such as cost savings, have not been employed to the point where they have had a negative impact on the effectiveness of the NZLAV fleet. The major caveat to this is the essential requirement for the appropriate notice to deploy. If immediate operational availability is used as the primary assessment criteria, then the supply chain is ineffective every year since the NZLAV was introduced.

4.4.2 Strong positive and negative views

Four areas of the survey assessed views on the NZLAV supply chain effectiveness, efficiency, empowerment, and the desire to operate outside of the prescribed system. Table 21 summarises the positive and negative spread of strong views for respondents' depending on their involvement or not in designing the supply chain.

Table 21: Summary NZLAV supply chain performance for respondents' holding strong views

Respondents' holding strong views				
Survey area	Not Involved in supply chain design		Involved in supply chain design	
	Positive	Negative	Positive	Negative
Effectiveness	85%	15%	60%	40%
Efficiency	70%	30%	50%	50%
Empowerment	15%	85%	50%	50%
Desire to operate outside the system ¹⁸	70%	30%	50%	50%

A relationship was anticipated between involvement in the supply chain design and attitude ratings; it was expected that those not involved in the supply chain design would return a greater quantity of stronger negative views and those involved in the supply chain design would return a greater quantity of stronger positive views. Table 21 shows that this anticipated relationship did not eventuate for all areas assessed in the survey. For those not involved in the supply chain design the anticipated relationship was proven to exist for empowerment survey area.

Table 21 further shows that those involved in the supply chain design returned a 50:50 spread of strong views for three out of the four survey areas. Although the anticipated relationship stated above was not seen, being involved in designing the supply chain should, at worst, have resulted in neutral or ambivalent views for the survey areas. The equal positive-negative spread of these finding should raise concerns for NZDF as it indicates that advice provided at the design stage is not heeded and performance is therefore being impeded.

4.4.3 Continuous improvement and empowerment

The results from the survey section on theories and practices that influence NZDF supply chain policy showed that Continuous Improvement (CI) was most often rated as the theory, idea or practice that influenced the NZDF. CI activities are often driven by the lower or lowest levels of an organisation, therefore a relationship is expected between the strong influence of CI and positive empowerment responses. Survey results for empowerment were negative indicating that there is an issue with the manner in which NZDF is conducting CI activities.

4.4.4 Re-allocation of supply chain decisions

The survey also asked respondents for their views on the current and future allocation of responsibilities for supply chain decisions. The differences between current and future allocation of the responsibilities are summarised in Table 22.

¹⁸ Positive performance in this area shows less desire or need to operate outside the prescribed system, negative performance shows an increased need or desire to ignore the prescribed rules in order to ensure the chain is successful.

Table 22: Summary differences for allocation of supply chain decisions

Management Level	Summary of changes
Strategic	Reduce burden of responsibilities on strategic level, increase responsibilities for the tactical level, but the operational level responsibilities remains unchanged. Notably, operational level should continue to be excluded from seven areas.
Tactical	Reduce burden of responsibilities on strategic level, increase responsibilities for tactical and operational levels. Operational level involvement exclusion should be reduced from four to two areas.
Operational	Reduce burden of responsibilities on strategic level, increase responsibilities for tactical and operational levels. Operational level should be involved in all responsibilities.

Although there are differences in opinion regarding what responsibilities should or should not be delegated, there is a consistent theme in that the higher level wants to retain responsibility rather than delegate it and the lower levels desire more responsibility than higher is willing to delegate. Strategic and tactical level respondents also desire more responsibilities than is recommended in literature. The researcher's conclusion is that the operational level of NZDF is undervalued and not trusted by higher management levels for its involvement in or making of supply chain decisions.

4.4.5 Delegating responsibility, accountability, and authority

Combining the survey results regarding levels of supply chain decision making and the delegation of responsibility, accountability and authority indicates that the current organisational management model in Figure 16 is incorrect. Figure 16 is a reflection of NZDF policy requiring responsibility to be delegated as low as possible.

The results from the survey section on delegating of responsibility, accountability, and or authority within the NZLAV supply chain showed that a greater agreeance in the individual factors being delegated than multiple factors delegated together. To be effective employees need to be delegated responsibility and authority, however the survey results shows that this occurs less than 42% of the time.

Figure 39 provides a more accurate model for the current structure.

Figure 39: Revised Current Organisational Management Model

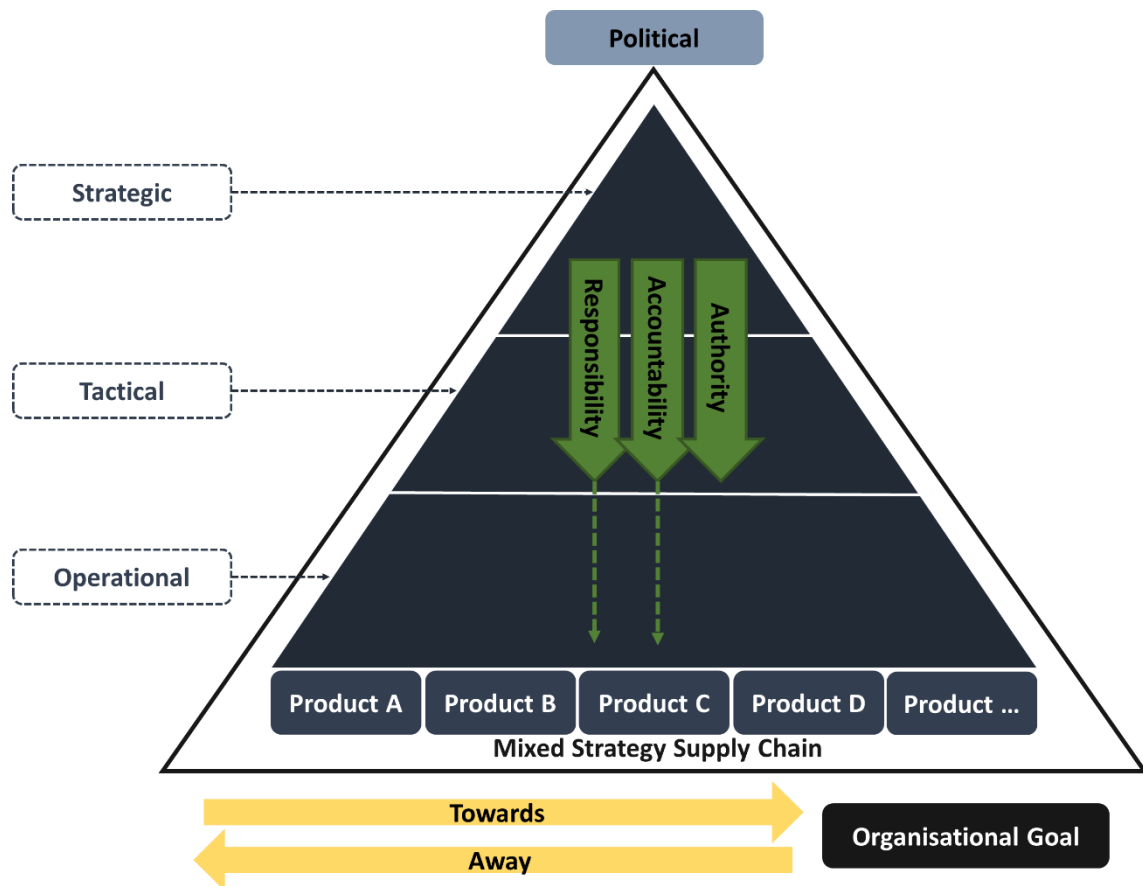


Figure 39 shows that control of the NZLAV supply chain is largely held above the operational level. It further shows that responsibility and accountability for a task is at times delegated, however authority will not be given to the operational level. The operator, as the face of the NZDF supply chain, is held responsible by the customer for meeting their needs. The operator's ability to deliver the standard of support necessary to the customer is constrained by having no authority to refine the plan to meet changing circumstances and by the likelihood of being held accountable if they were to refine it.

It is possible to conclude that the unwillingness to delegate sufficient responsibility, authority, and accountability is effecting the performance of the NZDF supply chain, but it is not clear as to the rationale for the unwillingness to delegate. An inference can be made from the research that a wider organisational perspective is essential to making the right decision; as this is only available to higher management levels, the operational level should not be given any authority. Further research into this area would be beneficial.

4.4.6 Valuing subordinate levels

The final area of the survey considered how higher management levels valued advice from subordinates levels. More than 70% of all respondents perceived that the strategic and tactical levels do not pay adequate attention to advice from the operational level. Negative responses were received from all three management levels and experience levels (length of service) within the NZDF. Positive responses only outweighed negative responses for survey respondents with 25 years or more service with the NZDF. The comments provided by respondents for this section were largely negative. They indicated that there was scope for the operational level to communicate with higher but this was drowned out by strategic and tactical priorities taking greater precedence, resulting in advice being dismissed without feedback reaching the operational level as to why advice was not heeded.

The failure to appropriately value and trust the operational level has created an obedient workforce that is unwilling to refine the plan given from higher, even if that decision would take the NZDF towards its organisational goal. This is a significant issue for the NZDF particularly as it shifts the supply chain from the benign, structured, slower moving domestic NZ environment to a deployed environment. To move or jump from an efficient supply chain to responsive or agile supply chain requires a thinking and engaged workforce, especially at the operational level, but the current organisational management model (Figure 39) does not create this.

5.0 Discussion and Observations on Survey Results

5.1 The supply chain context

The purpose of this research is to examine how organisational management models, outside of traditional corporate supply chains, drive supply chain success. The consequences of a supply chain failure in a military environment are significant to the point where it is used to justify the military as a unique organisation that does not need to apply supply chain theories designed to improve performance. Such rationale is similarly used by other self-determined “unique” organisations. Few, if any, non-commercial supply chain industries remain exempt from reviewing their supply chain designs and implement commercial SCM improvement concepts. The reduction in available resources (funding being one factor) is driving this need to improve supply chain performance, yet it comes with no reduction in the customer’s requirements; efficiency is needed without reducing effectiveness.

Strategic organisational documents are used to detail the direction a company will take, in the case of the NZDF they detail the complexity of environments that the NZ Army customers require force elements to deploy into and have supply chains established to support them. The Integrated Land Mission Model (Figure 15) suggests that environmental context needs to inform the structures that govern how the business will operate; organisational management models and supply chain designs should be adapted to the environment they are operating in. This supports by previous research, which has determined that supply chains should be designed in relation to their levels of supply and demand uncertainty (Lee, 2002) and that organisational management models are adapted as appropriate to the environment (Bernstein et al, 2016) (Osborn & Hunt, 2008) (Choi, Dooley, & Rungtusanatham, 2001).

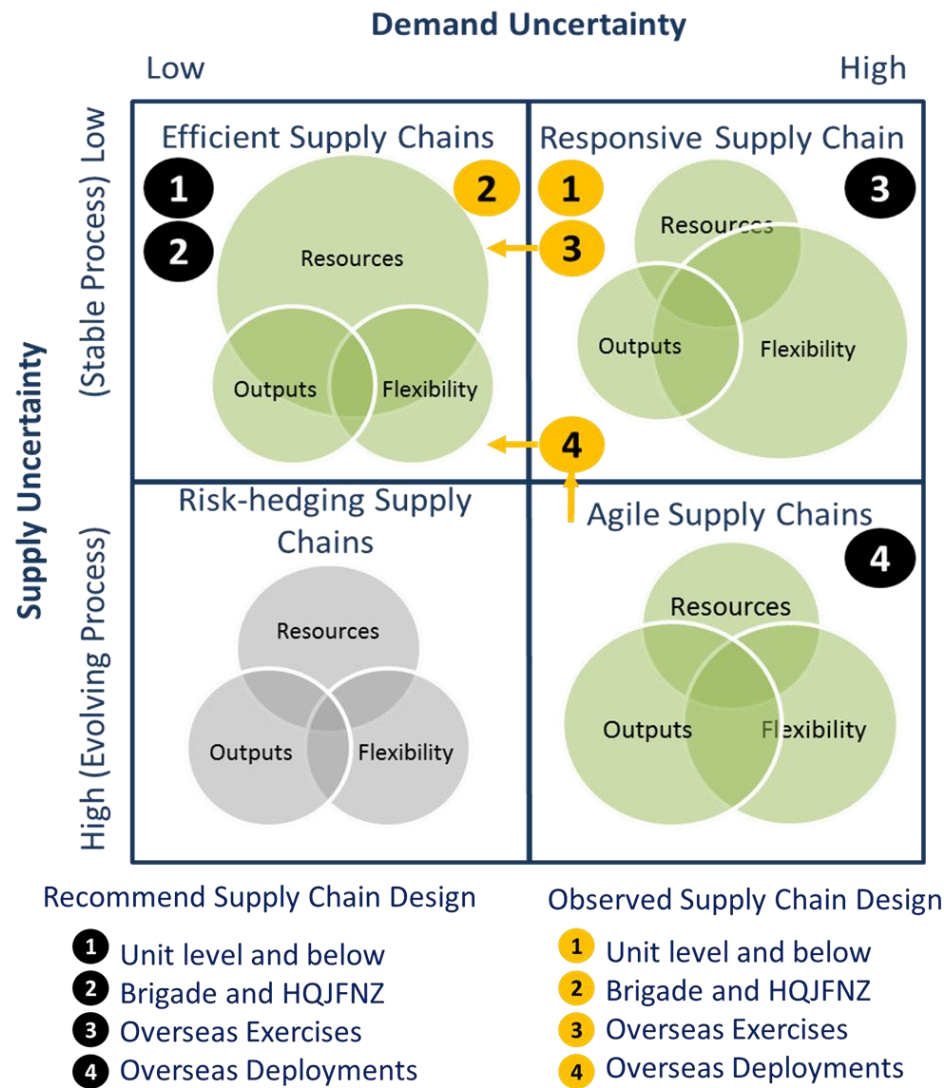
The four activity categories investigated as part of this research conformed to three of Lee’s supply chain designs – Unit level or below and Brigade and HQJFNZ activity categories are subjected to low supply and low demand uncertainties, which enable an efficient supply chain to be used; overseas exercise activity category is subjected to low supply uncertainty and high demand uncertainty, which require a responsive supply chain to be employed; overseas deployment activity category is subjected to high supply and high demand uncertainties, which require an agile supply chain to be employed. The use of Lee’s uncertainty model for categorising supply chains allows the survey results to be applicable to organisations operating in similar contexts.

Beamon (1999) contends that the supply chain elements of resources, outputs, and flexibility contribute to successful performance but that they must be considered in relation to each other.

Combining Beamon’s (1999) supply chain measurement system with Lee’s (2002) match strategy model provides a model for viewing adaptive supply chains (see Figure 10).

Figure 40 identifies the recommended supply chain design for the activity categories and also the supply chain design observed during the research.

Figure 40: Adaptive Supply Chain Model with survey results plotted



The arrows attached to ‘observed supply chain design’ results in Figure 40 indicate that the survey results were showing movement in the supply chain designed used for that category. The overseas exercises category is currently employing a responsive supply chain, however survey participants have seen a shift in policies towards the application of efficient supply chains for this category.

Figure 40 indicates that for an environment with low supply and low demand uncertainties (for the NZDF these are NZ based activities) an efficient supply chain design is recommended, where

the efficient use of resources drive supply chain design; high level of customer satisfaction (outputs) and flexibility are still desired but may be achieved with longer lead times.

Environments with low supply uncertainty but high demand uncertainty necessitate a responsive supply chain; for the NZDF the environment changes that occur with overseas exercises increase uncertainty in demands compared to NZ based activities. In a responsive supply chain environment customer service (outputs) is balanced with need for efficiency as it is difficult to justify increased expenditure, which can occur when making significant changes to inventory levels or maintenance plans, on a practice activity. Flexibility should drive supply chain design.

Operational deployments are the *raison d'être* for the NZDF and many international NGOs; these activities fall into the agile supply chain category due to the uncertainty of the task, location, and response time. Such activities require high levels of customer service (outputs), which can only be achieved with an equal importance placed on the ability to adapt to changes in environment or situation. Efficient use of resources may have less influence, however resources for operational deployments are limited and the efficient use of these resources remain a factor to sustaining high level of customer service.

5.2 Trade-offs: effectiveness against efficiency

Analysis of the NZDF enterprise application software data, SAP, showed that the NZLAV fleet was maintained to a high level when the appropriate notice to deploy is factored in (see Annex A – C). This high level of effectiveness comes at an increasing cost when the fleet's maintenance requirements are increasing. This would suggest that output and flexibility performance measures remained high priorities in the supply chain to sustain a high level of operational availability throughout various environments. Analysis of the SAP data would suggest that effectiveness had been emphasised over efficiency indicating that responsive or agile supply chains were employed.

Such conclusions are predicated on an assessment of the fleet wide operational availability and only post the appropriate notice to deploy; so they may be valid conclusions to get equipment to the start line of a task but may not be valid conclusions with regards to the sustainability of the supply chain. It is not a simple undertaking to shift a serviceable vehicle from NZ to replace an unserviceable vehicle on exercise in Australia or on deployment in Afghanistan, therefore a high fleet wide effectiveness may hide low effectiveness in specific environments or events.¹⁹ Without the appropriate notice to deploy the operational availability for the NZLAV fleet never gets above

¹⁹ It was not possible, within the timeframe for this research, to analyse operational availability specific to certain events.

73% in the 13 years. This would indicate that efficiency measures are influencing the supply chain design, through limitations on inventory holdings or repair personnel resourcing issues and potentially cost efficiency drivers. The negative attitudes and comments from survey respondents supports the conclusion that efficiency measures are impacting the NZLAV supply chain design and success.

Based on the SAP data and survey results (Annex F) the activity categories have been plotted on the adaptive supply chain model (Figure 40), detailing the supply chain design observed during the research for each category.

The percentage of respondents holding strong positive views for effectiveness and efficiency (see Annex F, Tables IX and X) for the Unit level or below category are high, indicating this category is not influenced by or is sheltered from efficiency measures. This suggests that the Unit has been allowed to or has chosen to use a Responsive Supply Chain – where flexibility to respond to changing environment has been given greater priority to conducting detailed planning and provisioning to ensure efficient use of resources.

The Brigade and HQJFNZ category was rated as the poorest performing category for effectiveness and efficiency, indicating that efficiency measures have a strong influence on the supply chain design. This would suggest that for Brigade and HQJFNZ activities the Responsive Supply Chain design is being applied; the negative performance and comments would suggest wider organisational issues.

The overseas exercise category results indicate it is less influenced by efficiency measures than the Brigade and HQJFNZ category, but the survey comments would indicate that procedural efficiency decisions limit the flexibility to respond to changes in demand requirement when away from NZ. Overseas exercises are likely to be designed around Responsive Supply Chain but trending towards Efficient Supply Chain.

The percentage of respondents holding strong positive views for effectiveness and efficiency for the overseas deployment category are high, indicating that customer satisfaction (outputs) and flexibility are prioritised over the efficient use of resources. However survey comments would indicate that customer satisfaction is impeded by efficiency measures in the NZ portion of the supply chain including decisions prior to deployment occurring. The efficiency measures regarding limitations on inventory, restrictions on distribution options and procedural delays would suggest that the overseas deployment category is employing a largely Responsive Supply Chain design that is trending towards an Efficient Supply Chain. This is instead of the Agile Supply Chain that is

recommended to meet the high supply and demand uncertainties that exist in the overseas deployment environment.

The available electronic data can be used to show that effectiveness is prioritised or, if used another way, that efficiency measures are driving the organisation towards a standardised 'efficient supply chain' regardless of where the activity falls in respect to Lee's uncertainty categories. When the survey results are added it becomes clearer that the organisation is striving towards standardisation rather than considering context when designing supply chains and supports the conclusion that a one dimensional organisational management model (Figure 39) is currently employed by the NZDF. This is reflective of the research into hierarchies and their inflexibility once formalised. The disadvantage of this inflexibility is that the rigid application of policy, procedures, and roles shapes an organisation for success in only one environment, in this case an environment that is low in supply and demand uncertainty.

5.3 Appreciating the value of all management levels

Organisations that employ continuous improvement (CI) strategies successfully empower their employees to make rapid improvements to and within the organisation (Jurburg, Viles, Tanco, & Mateo, 2017) (CSCMP, 2013). The survey results (see Annex F, Table XIII) showed that CI was the strongest influencer on NZDF supply chain policy. This should have translated into positive attitude survey responses showing a high level of empowerment across all management levels and compliance with organisational rules (see Annex F, Tables XI and XII).

Table 23: Summary of empowerment and organisational compliance

Survey Area	Percentage of Strong Views	
	Agreed	Disagreed
Empowerment	21.74%	78.26%
Did not desire or need to operate outside the prescribed system	66.67%	33.33%

As shown in Table 23, less than one quarter of respondents' held strong positive views towards empowerment within the NZDF. Instead of challenging the lack of empowerment, two thirds of respondents' indicated no requirement to operate outside the prescribed system. Furthermore survey respondents' involvement in the supply chain design was not a predictor for positive performance ratings across the survey areas, including empowerment; with those individuals involved in the design of an activity sometimes returning the strongest negative results (see Annex F, Figures IV – XIX).

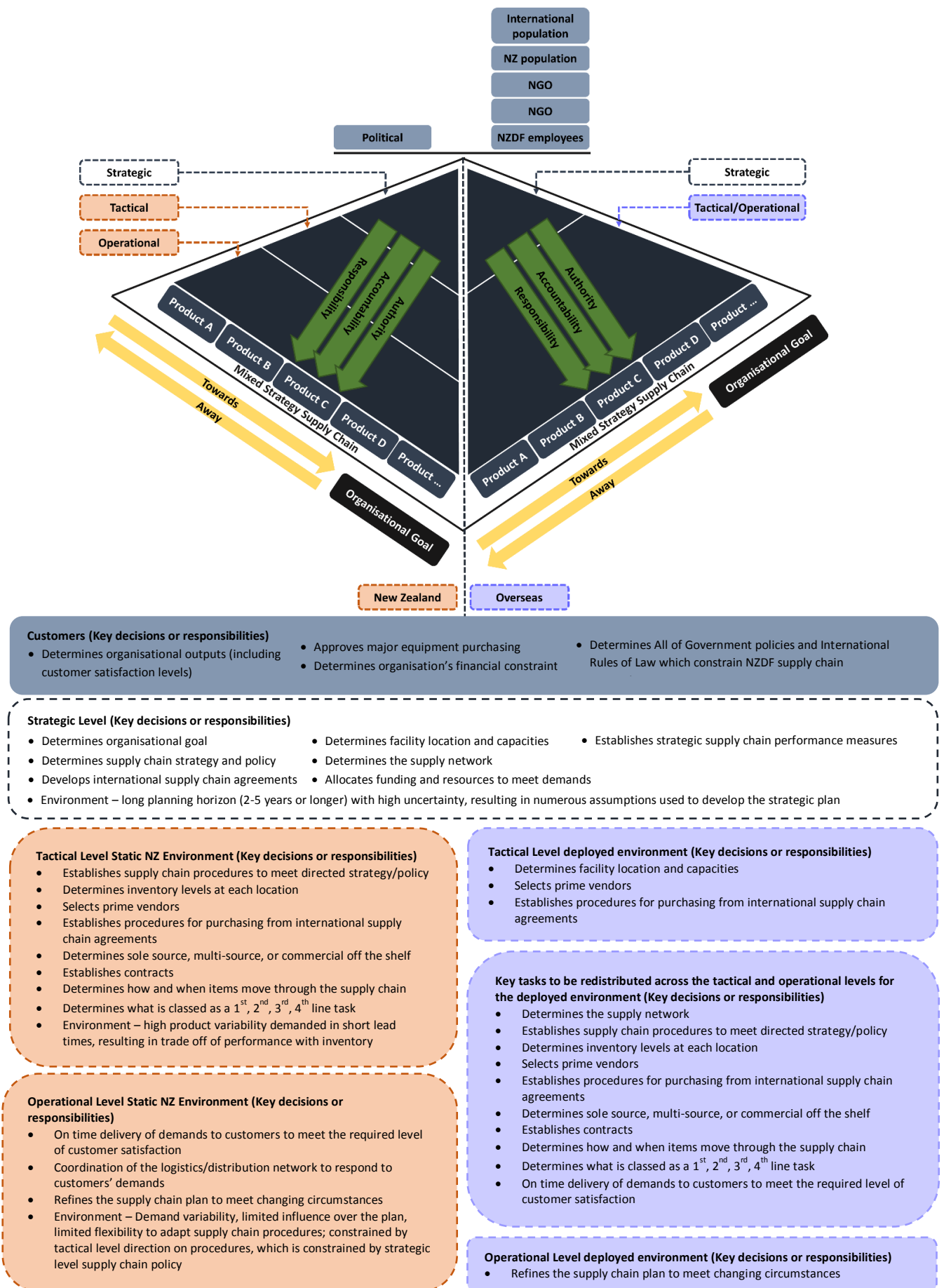
The negative results for empowerment, the unwillingness to challenge the system detailed by a higher authority, and the negative survey comments indicate that CI is not conducted effectively

and wider issues exist with organisational management design. The inability to influence performance despite being involved in the design of a supply chain for an activity supports this conclusion (as per Table 21).

The results for the survey section on 'levels of supply chain decision making' showed that the operational level's involvement in the NZDF supply chain is not valued for its ability to ensure successful organisational performance (see Annex F, Tables XIV – XVI and Figures XXI – XXVI). The unwillingness of operational level respondents' to allocate responsibilities for supply chain decisions to themselves is reflective of the negative empowerment results. Moreover results also showed the desire for higher NZDF management levels to retain responsibilities than to delegate them and exclude the operational level from certain aspects of supply chain decisions. Some survey respondents went a step further and commented that the operational level had little of value to add to discussions on supply chain design.

Survey results also showed that the strategic and tactical management levels paid insufficient attention to advice from the operational level (see Annex F Tables XIX – XXI and Figure XXVIII). The common theme of respondents' comments indicated that there was scope for the operational level to communicate with higher management levels but this was drowned out by higher level priorities taking greater precedence, resulting in advice being dismissed without feedback to the operational level. This level often, however, possesses vast levels of technical knowledge and current operational experience far in excess of their managers. Failure to inform subordinate management levels on why their advice was not heeded perpetuates the idea that their involvement is not valued. If such individuals are continually undervalued, they will not feel appropriately empowered, and they will not act to make changes to the supply chain even when it is crucial to NZDF's success.

Figure 41: Multi-dimensional Organisational Management Model



Sharply hierarchal organisations, such as the NZDF, create and value positional power and they often breed a competitive environment of winners and losers (Stimson & Appelbaum, 1988). Where positional power is tenuous leaders may prioritise their personal needs above others by retaining control of information or power (Maner & Mead, 2010), negatively impacting the ability to effect bottom up driven change. This is similar to the negative effects of power and status within hierarchical organisations researched by Magee & Galinsky (2008) and Overbeck & Park (2006). As discussed above this research found that the hierarchical management model employed by the NZDF does not encourage the participation or inclusion of the operational level in supply chain decisions. Instead the hierarchical structure and the negative effects of high powered managers who view the operational level as having a low status perpetuates the requirement to retain the authority for supply chain decisions at higher management levels with responsibility for the outcome of the decision delegated to lower levels.

To continue to move an organisation towards its goal (in this case study – the continued operational availability of a specific item of equipment) in spite of changing environments implies the need for an adaptive supply chain model (Figure 10) to meet the strategic direction and customers' needs. This supports the use of a multi-dimensional organisational management model (Figure 41, see above), where all layers are sufficiently empowered for the particular environment to make decisions that move the organisation towards its goal. Figure 41 demonstrates the necessity to balance the requirements of all customers of a supply chain (in this case NZDF).

Figure 41 shows that some environments where greater certainties exist, such as the static NZ environment, will allow for clearer delineation between the management levels for supply chain decisions. Figure 41 further shows that as the environment changes, due to increasing uncertainties with demand and supply, the delineation of supply chain decisions at the tactical and operational levels may change depending on who is best placed to ensure that the decision will continue to take the organisation towards its goal.

The strategic decisions are unlikely to change as these tend to be long term strategy and policy decisions that inform or shape the paths that can be taken by the tactical and operational levels. For example commercialisation and lean logistics are significant strategic decisions that can and do improve organisational performance, but they cannot be reversed overnight. Too lean and over commercialisation (or outsourcing) will impact upon the flexibility, which is required for a Responsive Supply Chain and the flexibility and achievement of outputs required for an Agile Supply Chain.

The need to empower all management levels within the supply chain is also demonstrated in Figure 41. Irrespective of the environment, where the responsibility for a supply chain decision has been delegated the authority and accountability must also be delegated. As detailed in Table 1, leadership success is predicated on having Responsibility and Authority; a leader with Authority but without Responsibility is dangerous, and with Responsibility but no Authority is ineffective and likely to disengage. The same applies to the supply chain; without the Authority to act, to make change, subordinate levels will continue to be ineffective in achieving their delegated Responsibilities.

Accountability can be viewed as an indivisible aspect of Responsibility (Lieutenant-Colonel Jon Burbee, 2007), however the survey results (see Annex F Tables XVII and XVIII) showed this is consistent for 53.64% of respondents. Further to this, the results showed that Accountability can exist without Responsibility or Authority. To be held liable for results without the responsibility for the performance of the task or the authority to change the circumstances creates discord within an organisation regarding, in this case, the supply chain design. This is reflected in the negative survey comments, where individuals were hampered in the achievement of outputs due to a lack of authority to change the supply chain and where then held accountable for this reduced performance by the customer.

5.4 Coherent supply chain strategy influencing organisational performance

There is no single NZDF policy document that details supply chain policy, instead this policy has to be inferred from government level documents such as the Defence White Paper, from command directives such as the Future Land Operating Concept 2035 (FLOC 35) and available policy and procedural documents for materiel management. The 2010 Defence White Paper, driven by the Value for Money Review, emphasised the need for efficiencies in the NZDF. This policy flowed down to NZDF policy documents and subsequently NZ Army procedural documents where efficiency and cost-effectiveness is stressed more than effectiveness. The research results displayed in Figure 40 support the NZDF movement towards Efficient Supply Chains, at least with respect to NZLAV.

The current NZ Government strategic direction, 2016 Defence White Paper, emphasises effectiveness and where it discusses efficiency it is generally in conjunction with effectiveness. The Defence Capability Plan 2016 links effective with efficient but affordability is stressed. These current documents support the selection of a supply chain design that balances efficiency and effectiveness specific to the activity category. The FLOC 35, released after the 2016 Defence White Paper, requires a supply chain that is simultaneously efficient and has high level of availability,

reliability, and flexibility in order to effectively respond to all contingencies detailed in the Integrated Land Missions model.

This current strategic direction for efficiency combined with a high level of effectiveness across multiple dimensions, supports the application of the Adaptive Supply Chain Model, but this has not been reflected in materiel management document updates for NZDF or NZ Army. Furthermore there is no direction in these strategic documents prioritising the supply chain expectations – where they cannot be achieved simultaneously, will efficiency (e.g. costs, resources) be traded for availability and flexibility? Figure 40 provides a method for considering the prioritisation of resources, outputs, and flexibility depending on uncertainties that exist in different dimensions. This direction needs to be part of NZDF's strategy as it will inform customers of the risks associated with the trade-offs (e.g. trading availability for efficiency carries the risk of requiring additional time and funding to bring equipment up to standard for a deployment).

This lack of clarity regarding supply chain policy is likely to have affected survey attitude scores, where respondents are applying the same customer service expectations (outputs) to all activity categories. The stress for efficiency in NZDF policy and NZ Army procedural documents is relevant to NZ activities but no longer relevant to other environments; they support the one dimensional organisational management model when higher level strategy documents are shaping towards a multi-dimensional model. These procedural documents are at the bottom of the hierarchal structure but as they have not been updated to reflect the changes in strategic documents, the NZDF is constrained and must obey them. The emphasis on efficiency in these documents is impacting performance of NZDF outside NZ. This lack of clarity regarding supply chain policy is also affecting the ability for individuals to allocate supply chain decisions and responsibilities to the appropriate levels within the NZDF and to delegate authority with responsibility and accountability to the operational level. The delay in translating political direction and strategic guidance into a coherent NZDF supply chain strategy and the subsequent updates of procedural documents is preventing the NZDF from utilising the adaptive supply chain model at Figure 40. The design and performance assessment of the supply chains for each activity category would then be dictated by the uncertainties of each environment. To continue with the current methodology where all activities are constrained to an efficient supply chain design and are assessed against responsive and agile supply chain performance expectations, will not enable the NZDF to be structured for success in the multi-dimensional environment of the Integrated Land Mission Model (New Zealand Army, 2017).

5.6 Critique of the research

Research Boundaries

This research was intentionally limited to the NZLAV and its operations within the NZ Army. This limitation on data sets resulted from available research time but it did allow for a level of consistency in research conditions which assists with improving the validity of conclusions. The reduced number of data sets enabled control over the number of variables and has provided the opportunity to analyse in depth how different organisational management models could be applied to improve the performance of the supply chain.

This research was largely based on qualitative primary data from survey responses and document analysis. This could be seen as a limitation however it was subjected to the validity and reliability criteria for qualitative research and survey data was assessed for its distribution and statistical significance. Primary quantitative data was also used in this research in the form of an enterprise application software system called Systems, Applications, and Products (SAP). SAP data is only accurate if it is entered accurately and there are no missing (un-entered) items. The researcher was limited in their ability to confirm the validity of SAP data; but it was assumed to be full and accurate.

A further limitation from the survey and SAP data was the restriction on the specificity of the data to an event and time. SAP data was not able to be interrogated to determine the operational availability of a specific set of NZLAV which participated in a specific event. This information may be available but was not obtainable within the research time frame. The survey was purposefully written to limit the indication of specific events and times. Due to the small size of the respondent population and the type of organisation, greater importance was placed on free and honest assessment and commenting on the performance of the NZLAV supply chain. Limiting the indication of specific events and times enabled the researcher to protect respondents' identities and obtain data applicable to the NZDF rather than comments aimed at the performance of specific individuals and their decisions.

An analysis of the Reliability, Availability, and Maintainability (RAM) engineering and supply chain decisions, which were made prior to the purchase or introduction of the vehicle, and that affect the whole of life support to the NZLAV was not conducted. Although this information is considered relevant for understanding the context of the original supply chain design, it was considered outside the scope of this research. The focus was on reviewing organisational management models to improve supply chain performance.

Applicability of research findings to other organisations

This research was conducted within a specific setting which creates the potential for conclusions to be viewed as only relevant to similar scenarios. The isolation of NZ and small size of the NZDF could create additional perception barriers, limiting the applicability of conclusions to other small isolated militaries or non-military organisations. This research is applicable to organisations that operate in multiple environments with mixed strategy supply chains using a hierarchal management structure and answering to multiple internal and external customers. Organisations that respond to Humanitarian Assistance and Disaster Relief (HADR) events are one type of non-military organisation that could consider this research as applicable to their organisations.

Researcher's involvement with the NZDF

A further limitation of this research is the researcher's involvement in the NZDF, currently employed by NZDF and previous experience with NZLAV. This is a research advantage as it improves the chances of including the correct population and allows for greater understanding of the context for survey comments. This enables more detailed interpretation of data but could bring into question independence and objectivity. The only overseas deployment data considered coming from the closed operation of the NZ Provincial Reconstruction Team located in Bamyan, Afghanistan. All information accessed and used in this research is publically available, unclassified information, or information that could be released under the Official Information Act (OIA). The researcher's involvement within NZDF constrains the publication of research findings unless approval is obtained from the Office of the Chief of NZDF. Access to raw equipment maintenance data is also constrained, with non-NZDF personnel required to submit an OIA request.

Survey Data

The NZLAV supply chain is a complex series of overlapping systems but it has a limited dispersion across the NZ Army and this allowed the survey population to be identified and contacted. This provides greater assurance that the survey data obtained was relevant to the NZLAV supply chain.

The researcher was limited to a short time period to conduct the survey, which may have reduced the number of responses received. The researcher received responses from 27.23% of the total population; this is below the average individual response rate of 52.7% or average organisation response rate of 35.7% determined by Baruch and Holtom (2008) however their results were based on the response rate of the sample rather than population. Therefore the 27.23% for this survey was considered acceptable. There was also potential for survey respondents to misinterpret the survey questions as not all the survey population have been exposed to supply chain terminology. This limitation was mitigated by including definitions for non-standard military terminology and using the military versions of the tactical and operational levels. Due to

limitations in research time, the researcher was unable, to assess the views of external organisations who are involved in aspects of the NZLAV supply chain. This additional data set could have enhanced the results by providing another perspective to the NZDF supply chain context, which does not operate in isolation, and relies heavily on external organisations for success.

It is necessary to consider if the data obtained from the survey respondents could be classed as a representative sample of the population. This would allow conclusions drawn from this survey to be considered applicable to the whole population and allow potential inferences to be made with regards to applicability of results and conclusions to other supply chain environments. Annex G provides the 'Descriptive Statistics' from Excel for survey responses. An analysis of the sample means, kurtosis, and skewness indicated that the survey responses were normally distributed (Norušis, 2008) (Deviant, 2017). Furthermore a one sample t-test was completed to determine the statistical relevance of survey results (Norušis, 2008) (Nolan, 1994). The survey returned a representative population sample and the results can be considered to be reflective of the whole population.

Research Limitations

This research has been intentionally limited to one fleet²⁰ of equipment within one organisation. This allows the NZDF's goal, with respect to that one fleet of equipment to remain constant, with the variables being the existing or previous environmental contexts in which that piece of equipment is utilised. This provides the opportunity to analyse how different SCM models affect one piece of equipment. This narrow scope of research is partially the result of time limitations, but also allows for clear delineation of this case study to a single fleet of equipment. Subsequent research could expand on this scope by utilising the data obtained to conduct what-if analysis with respects to alternative environmental context or additional equipment.

This research will be conducted within a specific setting which creates the potential for conclusions to be viewed as only relevant to similar scenarios. The research utilises a fleet of vehicles within NZ Army as the basis of the case study, however the supply chain discussed is the NZDF's supply chain. The conclusions drawn from this research could be applicable to the Royal NZ Navy, the Royal NZ Air Force, and other militaries striving for supply chain improvements. Organisations that operate in similar environments but with a less hierarchical structure to

²⁰ A fleet is a group of similar equipment designed for a specific task or group of tasks; fleet of heavy vehicles, communications fleet etc. There are three variants of NZLAV, however they are all the same basic vehicle and designed for use in the same environment; as such they are managed and referred to as one fleet.

militaries could also benefit from this research; contrasting their management models and supply chain successes with these research findings.

Additionally aspects of this research may be constrained by information security policies determined by the New Zealand Government, which could impact on the data available for research and subsequent validity of conclusions. Where raw data has been withheld, the researcher has provided the report parameters used to obtain the data to allow any interested parties to seek access at their own behest.

Further Research

Areas of further research areas could include:

- Applying the proposed management model, shown in Figure 41, to other equipment or capability fleets within the NZDF or other militaries with the activities that conform to Lee's uncertainty model. Altering these variables will potentially result in changing the processes, policies or even the organisations goal, which may result in different attitude scores or operational availability data. Such research would be beneficial for confirming the suitability of the proposed organisational management model and improve supply chain performance.
- Applying the proposed management model to organisations with potentially less hierarchal and or autocratic structures yet similar deployment locations, such as humanitarian NGOs could improve the applicability of research results.
- There is potential benefit in conducting longitudinal style research into all equipment or capability fleets deployed on a specific repeatable event. For example assessing the performance of the supply chain on the biennial Exercise Southern Katipo series in NZ or a repeated overseas exercise activity. Such research would assist with confirming or developing on research findings.
- The lack of a coherent supply chain policy and appropriate performance metrics is affecting the ability for NZDF to meet its obligations to its customers. This area of further research would benefit NZDF but it is likely to be subject to security restrictions regarding the exact nature of NZ Government directed outputs and the currency of equipment performance data selected. This is a valid and necessary area of research that may be better conducted on organisations not subject to security restrictions.
- The unwillingness to delegate control of the supply chain within sharply hierarchal organisation engenders a disengaged but compliant workforce. Further research into the use of power in hierarchal organisations on employee's perception of empowerment and success of continuous improvement programmes would also benefit the field of supply chain management.

6.0 Conclusion

The purpose of this research is to examine how organisational management models, outside of traditional corporate supply chains, drive supply chain success. This was achieved through examining the appropriateness of organisational management models to defined activity categories within a specific military SCM context in order to determine the levels of organisational success that could be achieved. An Adaptive Supply Chain Model (Figure 10) and the Proposed Organisational Management Model (Figure 17) were used to evaluate survey results and assess supply chain performance. The research produced a Multi-dimensional Organisational Management Model (Figure 41), which will assist organisations to shape management structures in a way that allows advances in SCM concepts to generate the desired supply chain performance improvement. When combined with a coherent supply chain strategy, the Multi-dimensional Organisational Management Model will enable success across all environments.

This section will provide answers and conclusions to the specific research questions proposed at the start of this thesis.

Question One:

What influences success for supply chains of organisations employing traditional hierarchical management structures?

Organisations employing traditional hierarchical management structures can and do have successful supply chains. The NZLAV supply chain is an example of this, however, only when considered as a single whole activity and factoring the appropriate notice to deploy. Success in this case study was shown to be negatively influenced by:

- A. slow adaptation of policy,
- B. hierarchal management structure,
- C. tightly held authority and responsibility at higher than necessary levels,
- D. the unsuccessful application of a Continuous Improvement (CI) programme, and
- E. the failure to prioritise supply chain performance requirements.

A review of NZDF supply chain drivers (Section 2.5) shows that SCM policy resulting from the Value for Money review, the Defence Transformation Programme and the 2010 Defence White Paper that prioritised efficiency over effectiveness has not been updated to reflect the 2016 Defence White Paper and FLOC 35 which balances or ties the two requirements together. Prioritising efficiency over effectiveness does not always translate into financial savings or improved organisational performance. For example, decreasing effectiveness by restricting maintenance actions because the priority was to save money fails to take into consideration the cost of

increased maintenance action required later. The best possibility is deferred cost, but often the costs increase (significantly) resulting in no savings. For the NZDF assessing performance primarily based on the efficient use of resources can result in a reduction of outputs, which is a reduction in effectiveness.

The ability to adapt has always been a requirement for ongoing success of any organisation, however in today's environment the speed at which an organisation can adapt is likely to be the biggest predictor of its success. Previous research has shown that hierarchical organisations and inflexible and senior managers are negatively influenced by high power they hold and the low status they place on subordinates' roles. To counter the slow pace at which hierarchical structures adapt to changes in environment, supply chain organisations have implemented CI programmes. The enforced hierarchal management structure and tightly holding the authority and responsibility for supply chain decisions at higher levels creates an environment where CI, a largely bottom up driven organisational improvement theory, cannot fully succeed. This is supported by the survey data at Annex F.

Question Two:

How does the organisation's environment and management structure shape supply chain design?

The NZDF, like a number of organisations, does not exist to make profits. Its organisational goal is to be operationally available to deploy into locations for the purposes of supporting its customers' aims. That customer base can be split across several segments (see Figure 41) – often political masters plus the populations being supported, each with their own view on customer satisfaction.

Organisations can either seek to balance the variety of customers' needs depending on the environment or prioritise one customer's needs above all others; either way organisational performance will be effected. Choi, Dooley, & Rungtusanatham (2001) highlighted that the advantage lies with those organisations that can alter their structures as the environment shifts. Ongoing supply chain success is therefore possible when customer's needs are traded-off and the supply chain designed depending on the environment. This research shows that the existing hierarchical management structure is shaping towards a standardised supply chain regardless of environment.

Question Three:

What supply chain decisions or responsibilities should be allocated to the strategic, tactical, and operational management?

This research found a strong desire for the case study organisation to hold authority and responsibility of supply chain decisions at a higher level than is normally recommended and contrary to its own policy. Table 15 indicates where the respondents considered that the authority for the supply chain decision could reside. Survey results (Section 4.3.6 Table 15 and Annex F) allocated six of supply chain decisions higher than literature's recommendations. None of the five areas that literature recommends should be allocated to the operational level were supported by the survey results, instead these areas remained allocated to the tactical level or shared responsibility between tactical and operational levels. The re-allocation of responsibilities indicated by the survey results are indicative of the static NZ environment.

At the strategic management level, the key decision area is to establish supply chain policy, as this not only influences both of the other strategic level responsibilities, but also drives all other management level decisions. At the tactical level, consideration must be given to how the associated responsibilities are related to, or influence, each other and how they will constrain the operational level. For example, lead time requirements and facility locations and capacities will influence inventory levels. Inventory levels will in turn influence operational level ability to deliver on time to customers in accordance with customers' differing satisfaction requirements. Supply chain procedures, contracts and whether procurement is sole source, multi-source, or commercial-off-the-shelf will constrain how the operational level can refine plans to meet changing circumstances. As highlighted above, the factors of power and status within hierarchical organisations impedes any desire to empower subordinate levels within the organisation. Successful supply chains will need to be adaptable, therefore it is essential for the operational level to have sufficient freedoms to refine the supply chain plan relative to their situation.

One key finding of this research was, regardless of where the authority and responsibility should reside, all management levels within the organisation should be able to provide advice on each area. This is especially important for subject matter experts at the operational level who must be able to advise higher levels of management on the likely result of a particular decision. Processes and procedures would needed to be put in place to prevent higher levels from having undue influence on decisions which lower levels should have the authority and responsibility for. This is critical for success in a strict hierarchal environment. While structure is important it needs to ensure that those at lower management levels within the organisation can freely challenge ideas,

concepts, or decisions without fear of reprisal. I.e. their challenge is not a personal affront but rather a well based professionally supported opinion.

Question Four

How should a hierarchical organisational management model be adapted to improve supply chain performance?

The allocation of authority and responsibility for supply chain decisions detailed above in Table 15 should apply to a low supply and low demand uncertainty environment, such as the static NZ environment for NZLAV. This allocation needs to be reviewed for each overseas supply chain, as the revised organisational management model in Figure 41 shows. The division of supply chain tasks for tactical and operational levels may need to change to ensure decisions in any deployed environment continue to move an organisation towards its goal.

Customer and strategic level supply chain decisions remain consistent in the new model, as they set the higher level policy and overarching supply chain strategy which is unaffected by environment. Although the customer may change (including, at least for this case study whomever the military's political masters are) the types of decisions made at this level do not change. There are some tactical and operational level decisions that will always remain in each space respectively.

At the tactical level these decisions are:

- A. determining facility location and capacities,
- B. selecting prime vendors, and
- C. establishing procedures for purchasing from international agreements.

At the operational level the one decision that will remain is the authority to refine the supply chain plan to meet changing circumstances. However remaining tactical and operational decisions need to be considered in light of the particular environments and customers.

Balanced command and, in this case, the ability to make and effect supply chain decisions, comes from having responsibility and authority for an action. Accountability needs to continue to be tied to responsibility as shown by survey results (see Annex F) and to authority as detailed in NZDF policy.

Where supply chain decisions are delegated to a subordinate level, responsibility, accountability, and authority for that decision must also be equally delegated.

Research Summary

This research utilised the New Zealand military context to understand organisational management models and their influences on supply chain design and success. For this case study organisation there is currently a disconnect between strategic level's expectations of its supply chain and the achievability of those expectations at the operational level, particularly given the method of control exerted on the supply chain by the strategic and tactical levels. The strategy demands a supply chain that can adapt to the uncertainties that exist in different operational environments, yet research findings show the dominance of an Efficient Supply Chain that only performs successfully in environments that are low in uncertainties.

The continued dismissal of advice or deliberate exclusion of those with technical knowledge or recent deployment experience will prevent the development of a supply chain strategy that matches strategic expectations with operational achievability. Reviewing empowerment within the supply chain, by delegating authority, accountability, and responsibility for decisions as appropriate to the environment, will also be necessary for ensuring success as the demand and supply uncertainties change.

It is likely that these findings would be replicated in other hierarchical organisations that are required to satisfy a wide variety of customers' needs across diverse operational environments.

Original Contribution

The Multi-dimensional Organisational management Model (Figure 41) provides a means of considering adjusting supply chain authority and responsibility for organisations that operate mixed strategy supply chains across changing environments. Although developed from a NZ land military context, it would be applicable to organisations that deploy to similar environments e.g. NGOs responding to HADR or higher threat environments. The model could also be applicable to other hierarchical structured organisations that need to adapt their supply chain designs to remain relevant in an ever changing market.

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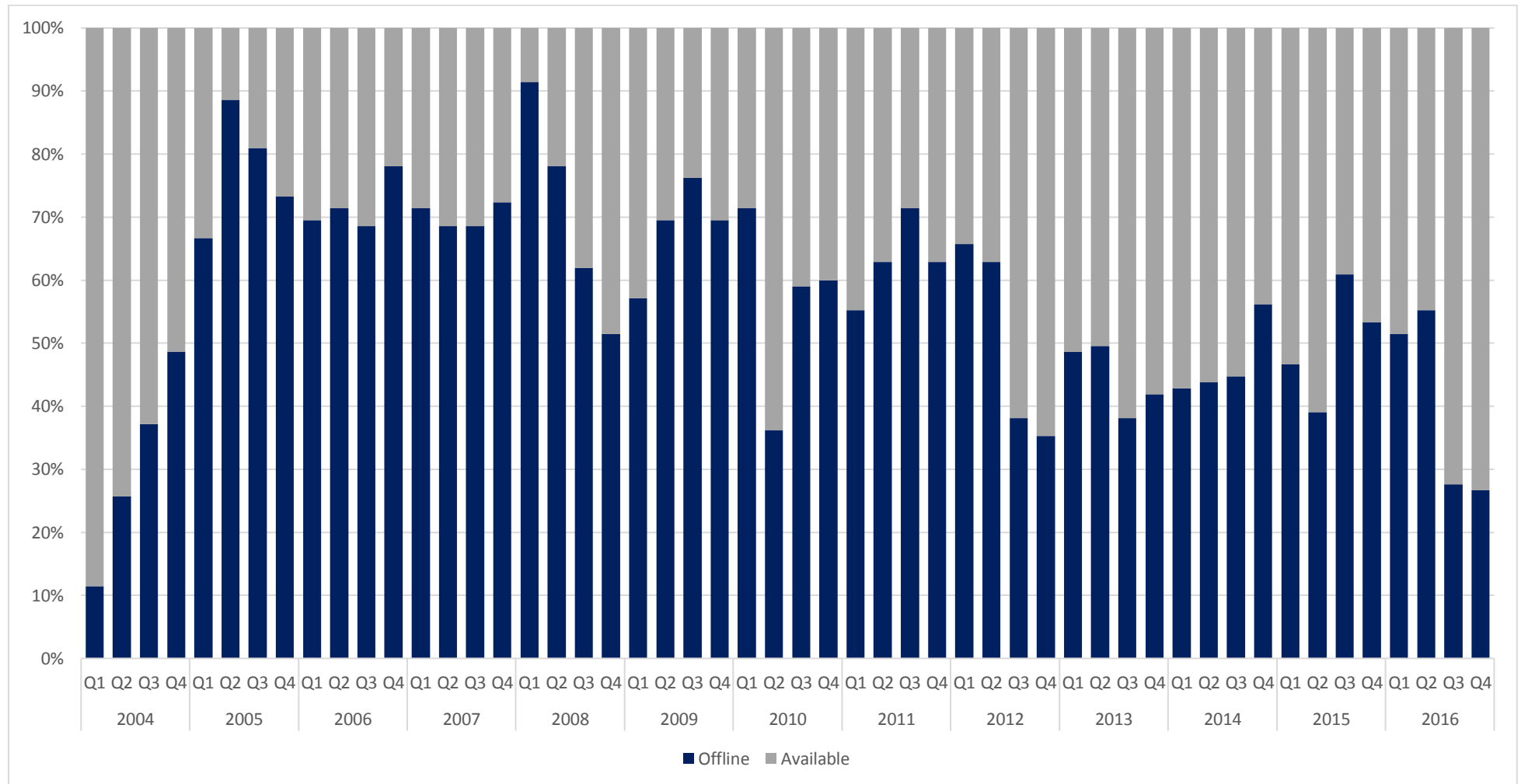
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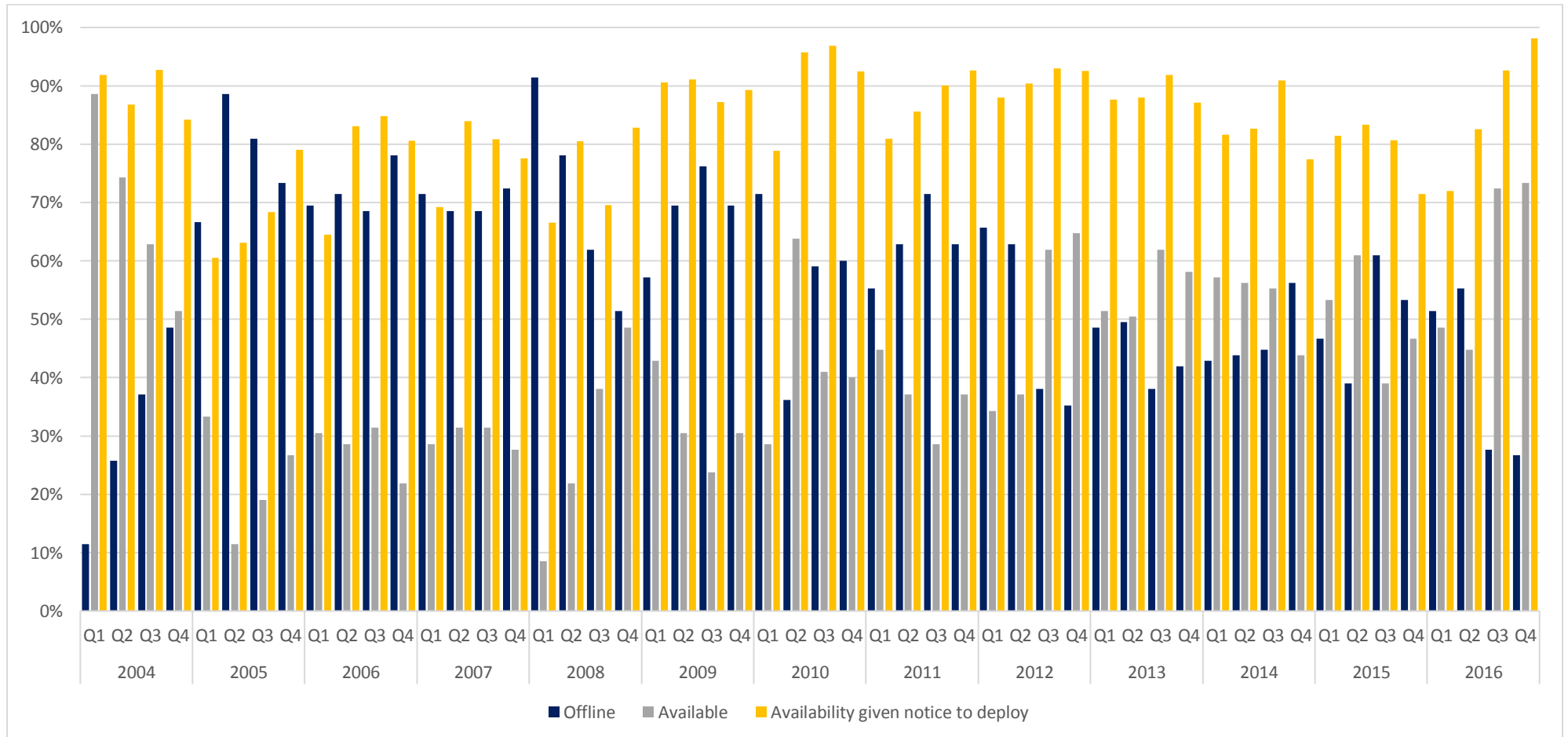
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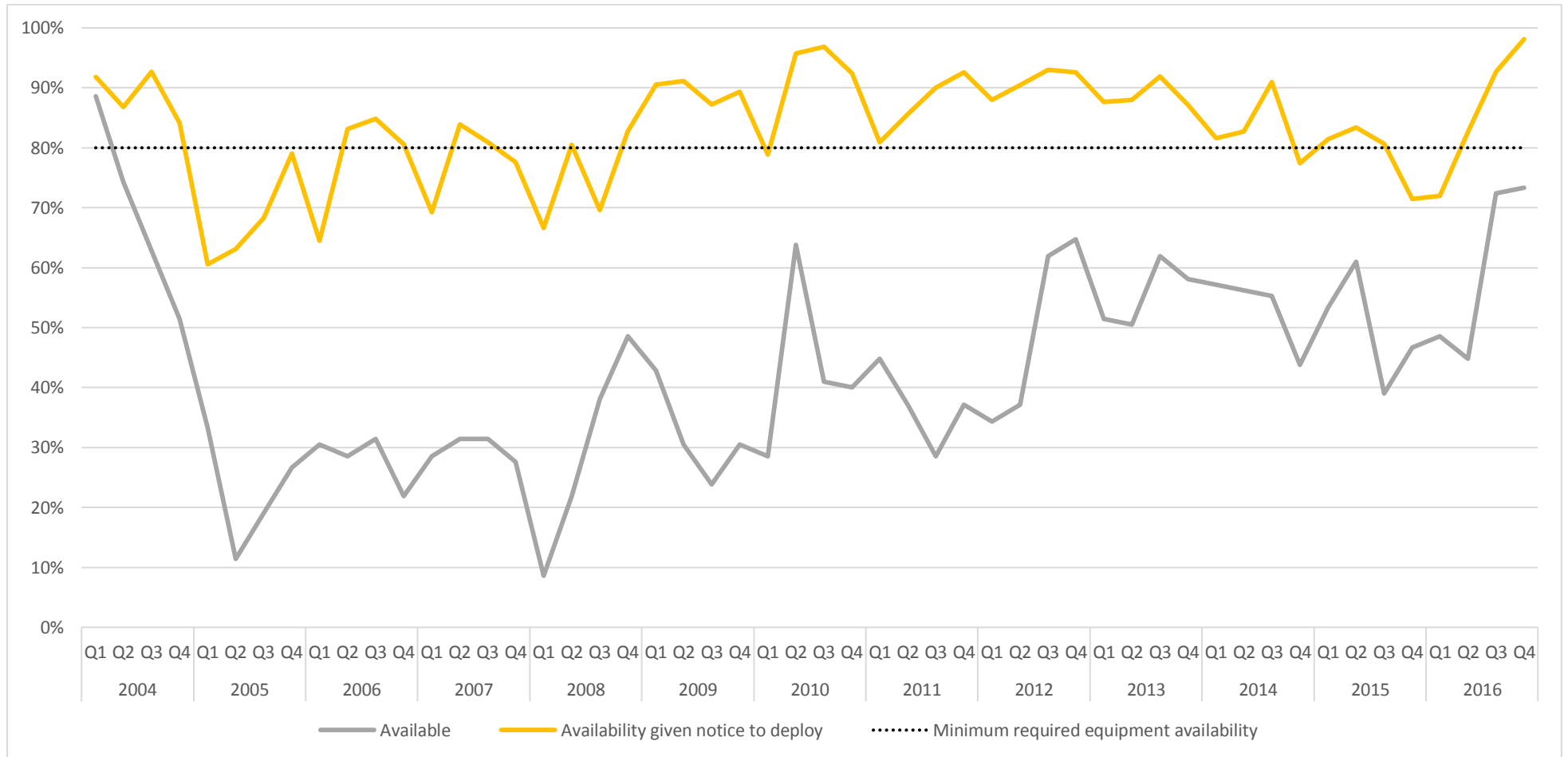
Annex A: NZLAV availability by quarter 2004 – 2016



Annex B: NZLAV availability by quarter given appropriate notice to deploy 2004 - 2016



Annex C: NZLAV availability status by quarter with minimum required availability 2004 - 2016



Annex D: Survey Information Sheet

NZLAV SUPPLY CHAIN POLICY AND IMPROVEMENTS

Information sheet for NZDF research participants

Thank you for considering to participate in this research. Please read this information sheet carefully before electing whether to participate or not. If you choose to take part I thank you. If you choose not to participate there will be no disadvantage to you of any kind.

What is the purpose of this research?

The need to conduct this research is to fulfil the requirements for the Master of Supply Chain Management at Massey University. The topic for this paper is “Reviewing the organisational management model to better support supply chain improvement strategies”. It takes the form of a case study analysis of NZDF supply chain policy and improvements using NZLAV as the focus equipment.

The objective of this research is to determine if there is a relationship between the levels of management (strategic, operational, and tactical) and the successfulness of supply chain improvements, with particular focus on the different environments NZLAV operate within.

What types of participants are being sought?

This survey is aimed at military and civilian personnel throughout NZDF who have had experience with the NZLAV's supply chain; including Crew Member, Supply Technicians, Workshops Tradesperson, Unit or Bde HQ, S4, personnel in HQJFNZ, and DLEM. An understanding of Supply Chain terminology is not essential, participants should feel comfortable to make comments using language they are comfortable and familiar with.

What will participants be asked to do?

Participants are asked to complete the attached questionnaire as honestly and completely as possible and return it by email to sheree.alexander@nzdf.mil.nz. This questionnaire will take approximately 20 minutes to complete.

The survey has four sections: Demographics, NZ exercises involving LAV, Overseas exercises or deployments involving LAV, and a general section on NZDF supply chain policy. You will be asked to respond to yes/no questions, questions where you will be asked to rate your response from strongly agree to strongly disagree, and questions which ask you to tick the category/s the statement best fits in. There is also scope for you to provide comments if you wish.

Following the completion of the questionnaire there may be a need to interview a smaller group of individuals to explore aspects of questionnaire findings in more detail. Completing the questionnaire does not obligate you to participating in an interview, you will be asked if you would be willing to be contacted regarding the possibility of being interviewed.

Will my taking part in the research be kept confidential?

As part of this questionnaire I will be asking you some basic details regarding you position and length of experience within the NZDF. This information will be used to describe the demographics of the population sample that responded. In lieu of your regimental number or rank and name, you will be asked to generate an Anonymous Research Code (ARC). You will be the only one who knows what your ARC is.

To further ensure your anonymity your survey and personal information will be assigned a code so that your answers can only be linked back to your ARC by the researcher. All results of the research will be presented in a fully de-identified form.

The data collected (questionnaire responses and coded results) will be stored securely in such a way that only the researcher will be able to gain access to it. No Cloud storage will be used for information that needs to be stored outside of NZDF Firewalls. Hardcopy data will remain in my possession or be in a locked cabinet inside a secured office. NZDF policies continue to govern the transmission of data when using NZDF systems.

At the end of the research any personal information will be destroyed immediately except for any raw data on which the results depend. This raw data will be retained (in secure storage) for five years, after which it will be destroyed.

Data will not be made available to other research without obtaining prior approval from participants.

What will happen to the results of the research?

The results of this research will form the basis of my thesis, which is submitted for marking by Massey University. NZDF will be briefed and informed of the findings of this research. There is a requirement to produce a journal article as part of the assignment requirements, however there it is not possible to confirm if this will be published at any stage. Prior to submitting any articles for publication it is an NZDF requirement to obtain approval from the CDF, this provides the NZDF the opportunity to formally review the results and conclusions to consider if it is appropriate for release to the public.

As a participant you are welcome to request a summary of the results of the survey should you be interested. Please use the contact details below to request a summary of results.

Has this research been approved?

This research has been approved by NZDF and has obtained Massey University ethics consent. If you should have any queries regarding the conduct of the research or the researcher you can inform Defence Human Resources or my paper supervisor (contact details below). Massey University ethics committee can also be contacted if you feel the options above are not appropriate.

What if participants have further questions?

If you have any questions about this research, now or in the future, please feel free to contact myself or my paper supervisor on the details below or NZDF Organisational Research by email OrgResearch@nzdf.mil.nz

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Kind regards,

Sheree Alexander
Major
EMGL Combat Systems
Messines Defence Centre, Trentham
Phone:
Email: sheree.alexander@nzdf.mil.nz

Walter Glass
Paper Supervisor
Corporate Logistics
PO Box 1401, Palmerston North
06 3514316
wmglass@corplogistics.co.nz

Annex E: Survey

NZLAV SUPPLY CHAIN POLICY AND IMPROVEMENTS

The need to conduct this research is to fulfil the requirements for the Master of Supply Chain Management at Massey University. The topic for this paper is “Reviewing the organisational management model to better support supply chain improvement strategies”. It takes the form of a case study analysis of NZDF supply chain policy and improvements using NZLAV as the focus equipment.

The objective of this research is to determine if there is a relationship between the levels of management (strategic, operational, and tactical) and the successfulness of supply chain improvements, with particular focus on the different environments NZLAV operate within.

The survey questions are preceded by definitions and two pictures describing NZLAV supply chains. The survey itself has four sections, please complete the sections that are relevant to your experience with NZLAV supply chains. This questionnaire will take approximately 20 minutes. Your time and input into this research would help to better inform this research and is greatly appreciated.

Sheree Alexander
Major, RNZALR

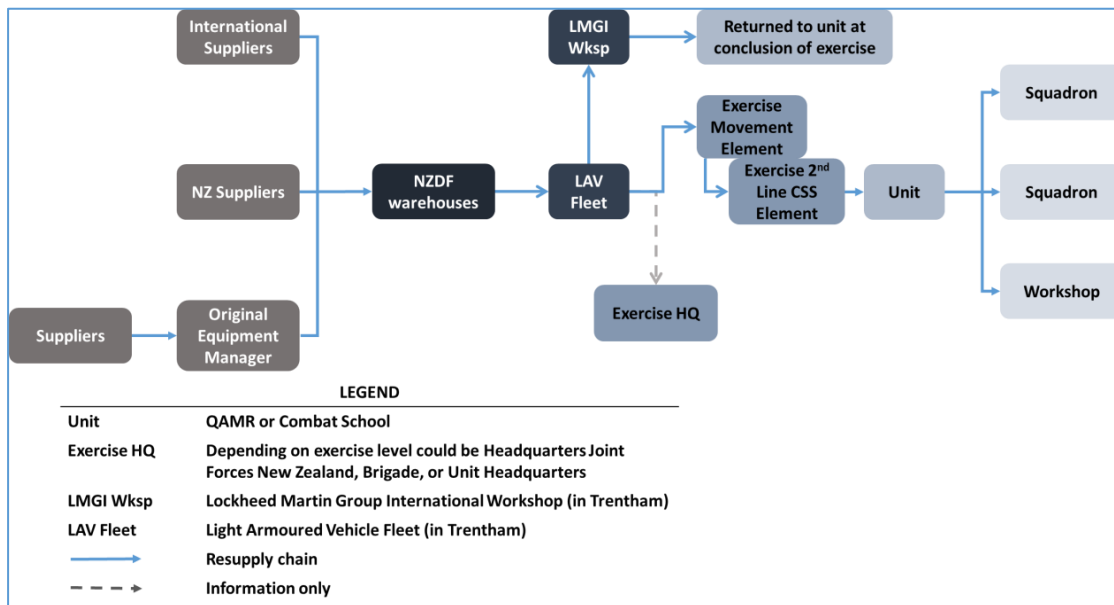
Definitions

NZLAV	Is the NZ Light Armoured Vehicle variant. This study focuses specifically on NZ Army’s experience with supply chains. Other countries LAV variants and their supply chains will be considered in future research.
Strategic	The military strategic level is responsible for the military aspects of planning and directing conflict. This level includes setting the military end state and the broad military approach to its achievement in order to support the national strategic aim.
Operational	At the operational level of war campaigns and major operations are planned and commanded. The operational level links military strategy to tactics by establishing operational objectives and end-states, initiating actions and applying resources to ensure the success of the campaign or operation.
Tactical	The tactical level is where the execution of the operation or campaign actually takes place.
Unit level or below	Unit level or below includes Battalion (such as 1 RNZIR, QAMR, 2CSSB), Sub-unit (Company or Squadron), and also Combat School activities.
Brigade	This is 1(NZ) Brigade and its predecessors and includes exercises such as Kiwi Koru, Alam Halfa
HQJFNZ	Headquarters Joint Forces New Zealand (includes Southern Katipo exercise series)
Effective	Maximising the achievement of outputs – right stuff, right place, right time and right quality.
Efficient	Maximising the use of available resources to meet demands – cost to the organisation is often the key factor. E.g. collating demanded parts and distributing them on a weekly basis as it is cheaper to send one full pallet than multiple part pallets on a more regular basis.
3rd/4th Line Support	For the purposes of this research 3 rd /4 th line support is any logistics support provided to the Brigade or HQJFNZ, but isn’t under the direct authority or command of Brigade or HQJFNZ. Some 3 rd /4 th line support units are DLEM and LMGI.
NSE	National Support Element

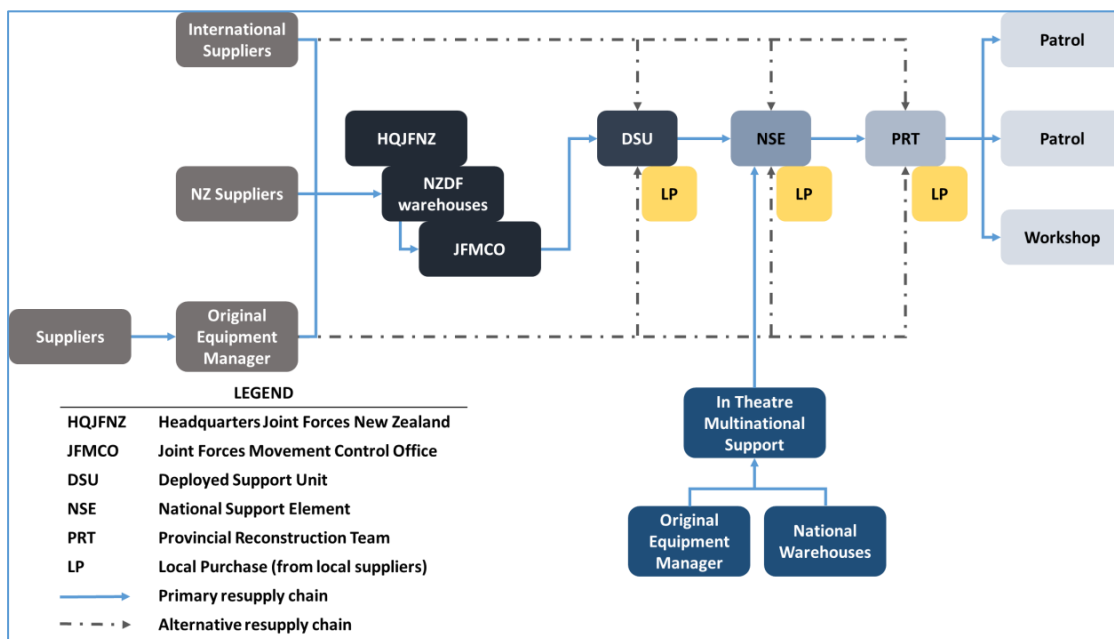
Rear echelon

Those individuals who remain behind in camps and bases but continue to directly support the exercises.

Supply Chain for New Zealand Exercises involving NZLAV



Supply Chain for Overseas Exercises or Deployments involving NZLAV



Research Participant Consent

I have read and understood the attached information sheet regarding this research. Any questions I have had regarding this research have been answered to my satisfaction. I understand that I am able to request further information at any stage. I acknowledge that:

- 1. My participation in the project is entirely voluntary and I will not be paid for my participation;
- 2. I'm free to withdraw my participation in this research at any stage without any disadvantage to me;
- 3. Personal identifying information (demographics) will be destroyed at the conclusion of the research, however any raw data on that the conclusions depend upon will be retained in secure storage for five years, after which they will be destroyed;
- 4. All results will be presented in a fully de-identified form and can be made available to participants at their request.

Therefore I agree to participate in this research ☐ Yes ☐ No

Anonymous Research Code (ARC)

An ARC allows a researcher to attribute responses to individuals whilst maintain a greater degree of anonymity than other forms of identification (such as Regimental Number and Surname). By using the ARC, you will be the only one who knows what your anonymous code is.

Spaces 1 and 2: **First two** letters of your mother's maiden name (e.g. For SMITH, you would write S|M)
Spaces 3 and 4: The numbers corresponding to **your month of birth** (e.g. For April, you would write 0|4)
Spaces 5 and 6: The **first two** letters of your father's first name (e.g. For JAMES, you would write J|A)
EXAMPLE ONLY: S|M|0|4|J|A Please do not use this example ARC as your ARC.

PLEASE ENTER YOUR ARC:

1	2	3	4	5	6
---	---	---	---	---	---

Based on the results of this survey it may be necessary to seek further information from participants, would you be willing to participate in an interview if required? If you wish to maintain your anonymity, that is understood, please tick no to participating in an interview. ☐ Yes ☐ No
If yes, please provide your preferred email address:

Section 1: Demographics

1.1 How would you classify your involvement with the NZLAV supply chain?

- ☐ NZLAV operator/user of NZLAV supply chain (including Crewman, Workshop tradesperson)
- ☐ Supply Technician (Pte – Sgt)
- ☐ Supply Chain Manager (Supply Technician SSgt - WO2, Sub-unit Commander)
- ☐ Headquarters (Unit, Bde, HQJFNZ etc)
- ☐ Fleet management
- ☐ Other (please specify) _____

1.2 Which level of the NZLAV supply chain was your involvement at? (if you operated across more than one level, please select the level you spent the most time at)

- ☐ Strategic
- ☐ Operational
- ☐ Tactical

1.3 How many years' experience have you had with the NZLAV supply chain?

- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 10-15 years
- ☐ 16+ years

1.4 How many years have you been with the NZDF?

- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 10-15 years
- ☐ 16-20 years
- ☐ 21-25 years
- ☐ 25+ years

Section 2: New Zealand Exercises involving NZLAV

2.1 Have you participated in activities involving NZLAV at the following levels? (Participation includes those providing rear echelon or 3rd/4th Line support from a camp/base.)

- (a) **Unit level or below** ☐ Yes If yes, please complete all (a) questions below. ☐ NA If NA, please do not complete the (a) questions below.
- (b) **Brigade and HQJFNZ** ☐ Yes If yes, please complete all (b) questions below. ☐ NA If NA, please do not complete the (b) questions below.

2.2 How many times have you participated in activities involving NZLAV at the following levels?

- (a) **Unit level or below** ☐ Once ☐ 2-9 ☐ 10 or more ☐ NA
- (b) **Brigade and HQJFNZ** ☐ Once ☐ 2-4 ☐ 5 or more ☐ NA

2.3 Were you involved in determining the structure of the NZLAV supply chain, policies or procedures for exercises at the following levels?

- (a) **Unit level or below** ☐ Yes ☐ No ☐ NA
- (b) **Brigade or HQJFNZ** ☐ Yes ☐ No ☐ NA

2.4 The NZLAV supply chain, policies and procedures were *effective* in providing support for exercises at the following levels. (Please circle the number that best represents how much you agree with the statement)

- (a) **Unit level or below**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA
- (b) **Brigade or HQJFNZ**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

2.5 The NZLAV supply chain, policies and procedures were *EFFICIENT* in providing support for exercises at the following levels. (Please circle the number that best represents how much you agree with the statement)

- (a) **Unit level or below**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA
- (b) **Brigade or HQJFNZ**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

2.6 I felt empowered to make improvements to the NZLAV supply chain, policies or procedures for exercises at the following levels. (Please circle the number that best represents how much you agree with the statement)

- (a) **Unit level or below**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA
- (b) **Brigade or HQJFNZ**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

2.7 I did not need to (or wish to) operate outside of the prescribed NZLAV supply chain, policies or procedures for exercises at the following levels. (Please circle the number that best represents how much you agree with the statement)

(a) Unit level or below

Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

(b) Brigade or HQJFNZ

Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

2.8 If you answered the (a) questions above, please provide any further comments you have on the NZLAV supply chain for exercises at the Unit level or below.

2.9 If you answered the (b) questions above, please provide any further comments you have on the NZLAV supply chain for exercises at Brigade or HQJFNZ level.

Section 3: Overseas Exercises or Deployments involving NZLAV

3.1 Have you participated in activities involving NZLAV at the following levels? (Participation includes providing NSE, rear echelon, 3rd/4th Line support, and planning support.)

- (a) **Overseas exercises** ☐ Yes If yes, please complete all (a) questions below. ☐ NA If NA, please do not complete the (a) questions below.
- (b) **Overseas deployment** ☐ Yes If yes, please complete all (b) questions below. ☐ NA If NA, please do not complete the (b) questions below.

3.2 How many times have you participated in activities involving NZLAV at the following levels?

- (a) **Overseas exercises** ☐ Once ☐ Twice ☐ Three or more ☐ NA
- (b) **Overseas deployment** ☐ Once ☐ Twice ☐ Three or more ☐ NA

3.3 Were you involved in determining the structure of the NZLAV supply chain, policies or procedures for the following activities?

- (a) **Overseas exercises** ☐ Yes ☐ No ☐ NA
- (b) **Overseas deployment** ☐ Yes ☐ No ☐ NA

3.4 The NZLAV supply chain, policies and procedures were *effective* in providing support for the following activities. (Please circle the number that best represents how much you agree with the statement)

- (a) **Overseas exercises**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA
- (b) **Overseas deployment**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

3.5 The NZLAV supply chain, policies and procedures were *EFFICIENT* in providing support for the following activities. (Please circle the number that best represents how much you agree with the statement)

- (a) **Overseas exercises**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA
- (b) **Overseas deployment**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

3.6 I felt empowered to make improvements to the NZLAV supply chain, policies or procedures for the following activities. (Please circle the number that best represents how much you agree with the statement)

- (a) **Overseas exercises**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA
- (b) **Overseas deployment**
Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

3.7 I did not need to (or wish to) operate outside of the prescribed NZLAV supply chain, policies or procedures for the following activities. (Please circle the number that best represents how much you agree with the statement)

(a) Overseas exercises

Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

(b) Overseas deployment

Strongly agree 1 2 3 4 5 6 7 8 9 10 Strongly disagree ☐ NA

3.8 If you answered the (a) questions above, please provide any further comments you have on the NZLAV supply chain for overseas exercises.

3.9 If you answered the (b) questions above, please provide any further comments you have on the NZLAV supply chain for overseas deployments.

Section 4: NZDF supply chain policy

4.1 What supply chain theories, ideas, or best business practices currently influence NZDF supply chain policy? (Multiple responses allowed)

- ☐ Lean
- ☐ Agile
- ☐ Continuous improvement
- ☐ Vendor managed inventory
- ☐ Enterprise Resource Planning
- ☐ Optimisation of inventory holdings
- ☐ Direct supply agreements (purchase directly off supplier for immediate consumption)
- ☐ Commercialisation of NZDF (privatisation, outsourcing (3rd or 4th Party Logistics), strategic partnering, simple supply contracts)
- ☐ All of the above
- ☐ None – the NZDF does not have a supply chain policy.
- ☐ Other (please specify) _____

4.2 Please tick what decisions are made or responsibilities currently exist at the following levels of command? (Multiple responses allowed)

In respects to the NZDF supply chain, which level currently ...	Strategic	Operational	Tactical
Establishes policy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develops international agreements (Implementing Agreement, Memorandum of Understanding)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines facility locations and capacities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines the supply network	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allocates funding and resources to meet need	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establishes procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines inventory levels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Selects prime vendors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establishes procedures for procuring through international agreements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines whether sole source, multi-source, or commercial off the shelf	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines lead time requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establishes contracts with providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines how and when items move through the chain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines what is classed as 1 st , 2 nd , 3 rd , 4 th line task	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determines local purchase constraints	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Refines the plan to meet changing circumstances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On time delivery of demands to customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coordination of the distribution network to respond to customers' demands	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4.3 Please tick what decisions or responsibilities *should be delegated* to the following levels of command? (Multiple responses allowed)

In respects to the NZDF supply chain, which level should ...	Strategic	Operational	Tactical
Establish policy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develops international agreements (Implementing Agreement, Memorandum of Understanding)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine facility locations and capacities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine the supply network	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allocate funding and resources to meet need	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establish procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine inventory levels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Selects prime vendors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establish procedures for procuring through international agreements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine whether sole source, multi-source, or commercial off the shelf	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine lead time requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establish contracts with providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine how and when items move through the chain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine what is classed as 1 st , 2 nd , 3 rd , 4 th line task	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine local purchase constraints	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Refine the plan to meet changing circumstances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On time delivery of demands to customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coordinate of the distribution network to respond to customers' demands	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4.4 Does the NZDF delegate Responsibility, Accountability, and/or Authority to act with respects to NZLAV supply chains to the following levels? (Responsibility, accountability, and authority are defined below.)

Responsibility	The obligation to perform a task, function, or activity assigned to an appropriate standard.
Accountability	The assurance that an individual or an organisation will be evaluated on their performance of the task, function, or activity assigned, and rewarded or disciplined based on the evaluation.
Authority	The right or power assigned in order to achieve the task, function or activity. This includes the right or power to change procedures if necessary to achieve the task, function or activity.

From Strategic to Operational:

- ☐ Responsibility
- ☐ Accountability
- ☐ Authority

From Operational to Tactical:

- ☐ Responsibility
- ☐ Accountability
- ☐ Authority

4.5 Do strategic and operational level commanders pay adequate attention to advice provided by tactical commanders and LAV operators?

☐ Yes

☐ No

If yes, please list the main issues that arise as a result. If no, please move to question 4.6.

4.6 Please provide any further comments you have on NZDF supply chain policy in regards to NZLAV.

Annex F: Survey Data

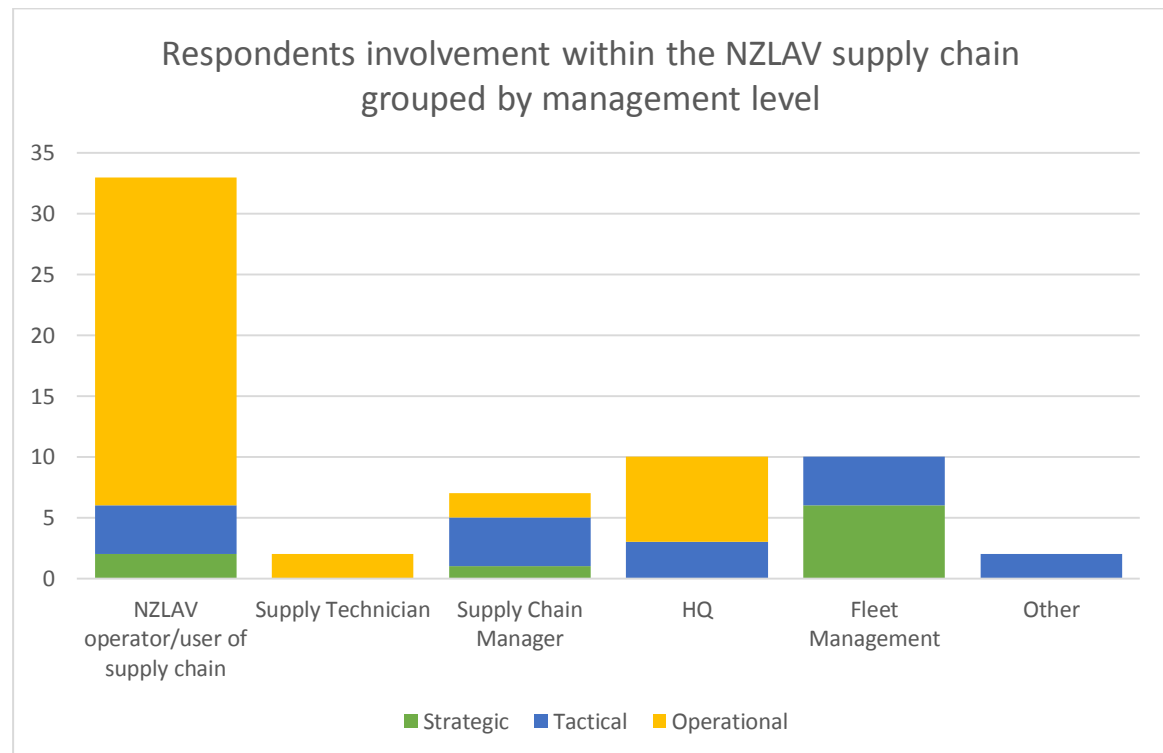
Table I

Survey Question 1.1 How would you classify your involvement with the NZLAV supply chain?		
Supply chain involvement	Total Responses	Percentage of Responses
NZLAV Operator or User of the supply chain	33	51.56%
Supply Technician	2	3.13%
Supply Chain Manager	7	10.94%
Headquarters personnel	10	15.63%
Fleet Management	10	15.63%
Other ¹	2	3.13%
Total	64	

Table II

Survey Question 1.2 Which level of the NZLAV supply chain was your involvement at?		
Management Level	Total Responses	Percentage of Responses
Strategic	9	14.06%
Tactical	17	26.56%
Operational	38	59.38%
Total	64	

FIGURE I



¹ A review of the survey responses showed that both these individuals would be classified as Supply Chain Managers in commercial terminology.

Table III

Survey Question 1.3 How many years' experience have you had with the NZLAV supply chain?		
Experience with NZLAV	Total Responses	Percentage of Responses
1-5 years	32	50.00%
6-10 years	16	25.00%
11-15 years	13	20.31%
16+ years	3	4.69%
Total	64	

Table IV

Survey Question 1.4 How many years have you been with the NZDF?		
Experience within NZDF	Total Responses	Percentage of Responses
1-5 years	7	10.94%
6-10 years	15	23.44%
11-15 years	13	20.31%
16-20 years	8	12.50%
21-25 years	5	7.81%
25+ years	16	25.00%
Total	64	

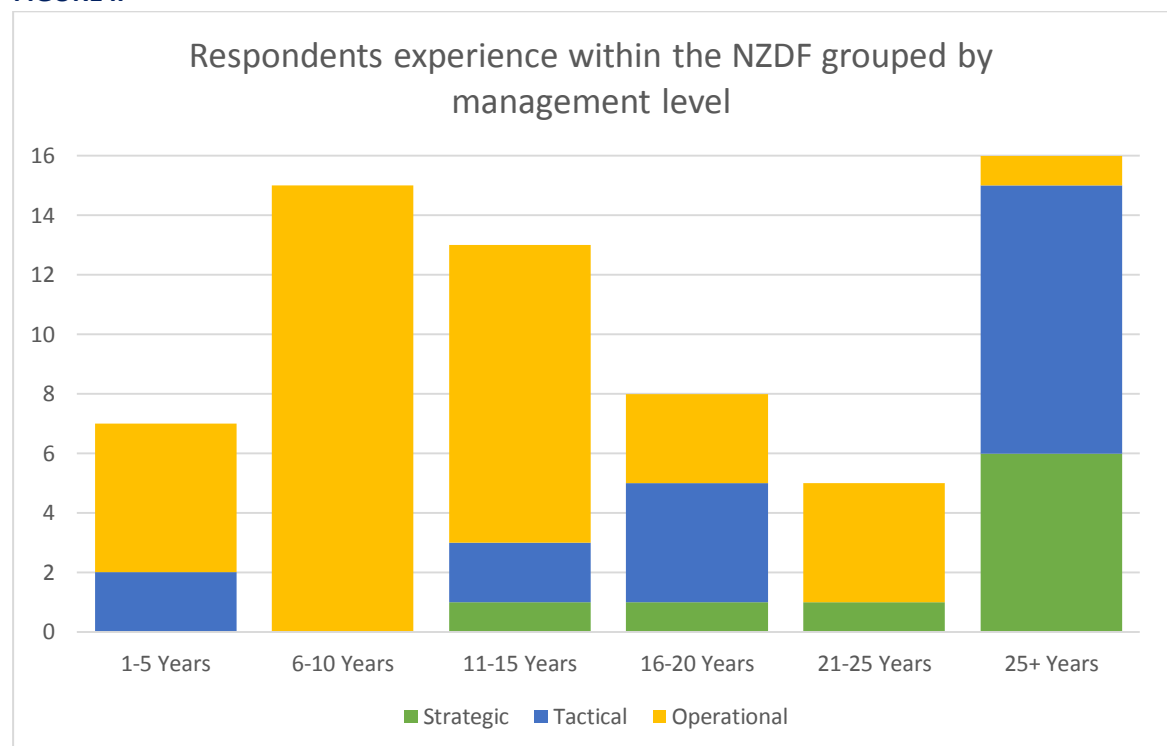
FIGURE II

Table V

Have you participated in activities involving NZLAV ...			
Survey Question	Activity category	Yes	Percentage of Total Survey Respondents
2.1a	at the Unit level or below?	55	85.94%
2.1b	at the Brigade or HQFJNZ level?	31	48.44%
3.1a	on overseas exercises?	43	67.19%
3.1b	on overseas deployments?	27	42.19%

Table VI

How many times have you participated in activities involving NZLAV...				
Survey Question	Activity Category	Once	Some	Often
2.2a	at the Unit level or below?	1	21	32
2.2b	at the Brigade or HQFJNZ level?	4	14	12
3.2a	on overseas exercises?	24	11	6
3.2b	on overseas deployments?	19	6	3

Table VII

Frequency of participation responses grouped by length of experience within NZDF							
Activity Category	Frequency	1-5 Years	6-10 Years	11-15 Years	16-20 Years	21-25 Years	25+ Years
Unit level or below	once	0	1	0	0	0	0
	some	5	3	4	1	1	7
	often	2	11	8	6	4	1
Brigade and HQFJNZ	once	1	0	1	1	0	1
	some	1	4	1	3	4	1
	often	1	3	2	1	0	5
Overseas Exercise	once	4	7	4	5	3	1
	some	1	2	2	2	1	3
	often	0	0	0	1	1	4
Overseas Deployment	once	0	4	5	3	2	5
	some	0	1	0	2	1	2
	often	0	1	0	0	0	2

Table VIII

Were you involved in determining the structure of the NZLAV supply chain, policies, or procedures for exercises or activities at ...			
Survey Question	Activity Category	Yes	No
2.3a	Unit level or below	13	38
2.3b	Brigade and HQFJNZ	7	22
3.3a	Overseas exercises	9	32
3.3b	Overseas deployments	12	15

FIGURE III

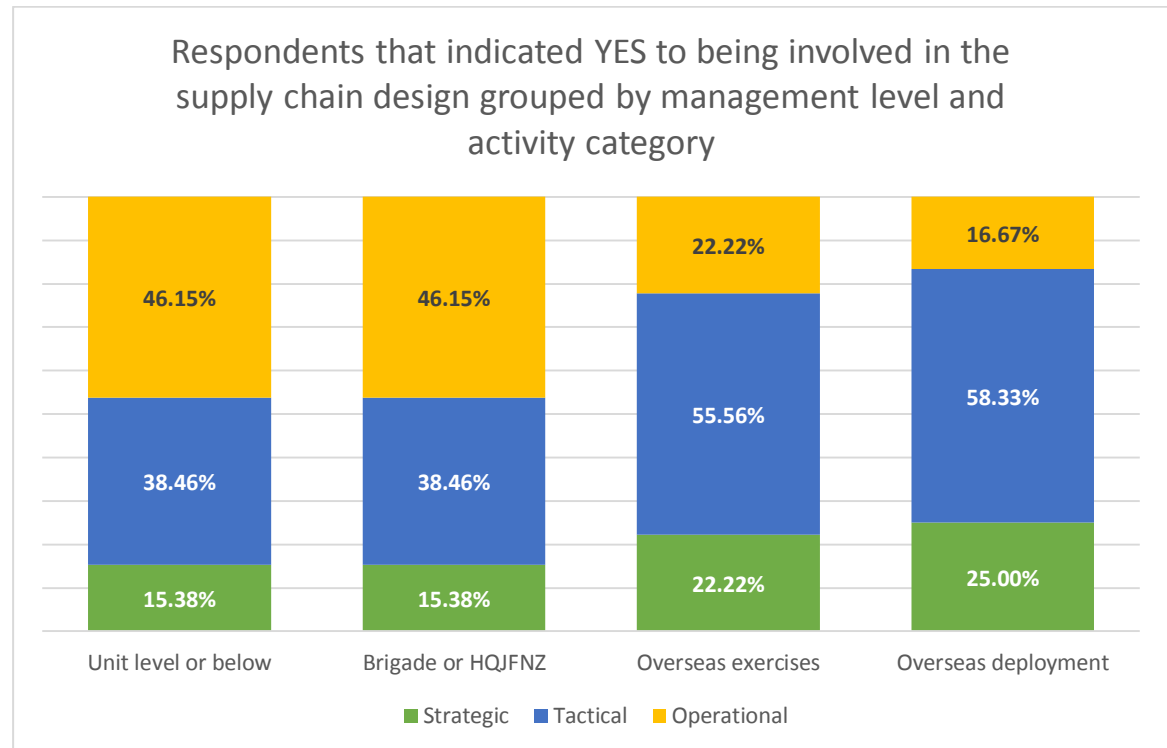


Table IX

Effectiveness												
The NZLAV supply chain, policies, and procedures were effective in providing support for exercises or activities at the following levels:		Strongly Agree	Agree		Ambivalent	Neutral		Ambivalent	Disagree		Strongly Disagree	Activity response total
Survey Question	Activity Category	1	2	3	4	5	6	7	8	9	10	
2.4a	Unit level or below		3	16	8	10	5	5	1	2	1	51
2.4b	Brigade and HQJFNZ			2	5	8	5	5		2		27
3.4a	Overseas exercises	2	5	6	8	6	3	8	1	1	1	39
3.4b	Overseas deployments	1	4	4	5	1	3	7	1			25
Rating Total		3	12	28	26	25	16	25	3	5	2	
Percentage of strong views		81.13%			NIL				18.87%			

The following graphs display survey responses regarding effectiveness for each activity category, grouped by respondents' management level. These graphs also show how many respondents for each attitude score (1 – 10) were involved in the design of the supply chain for that activity category.

FIGURE IV

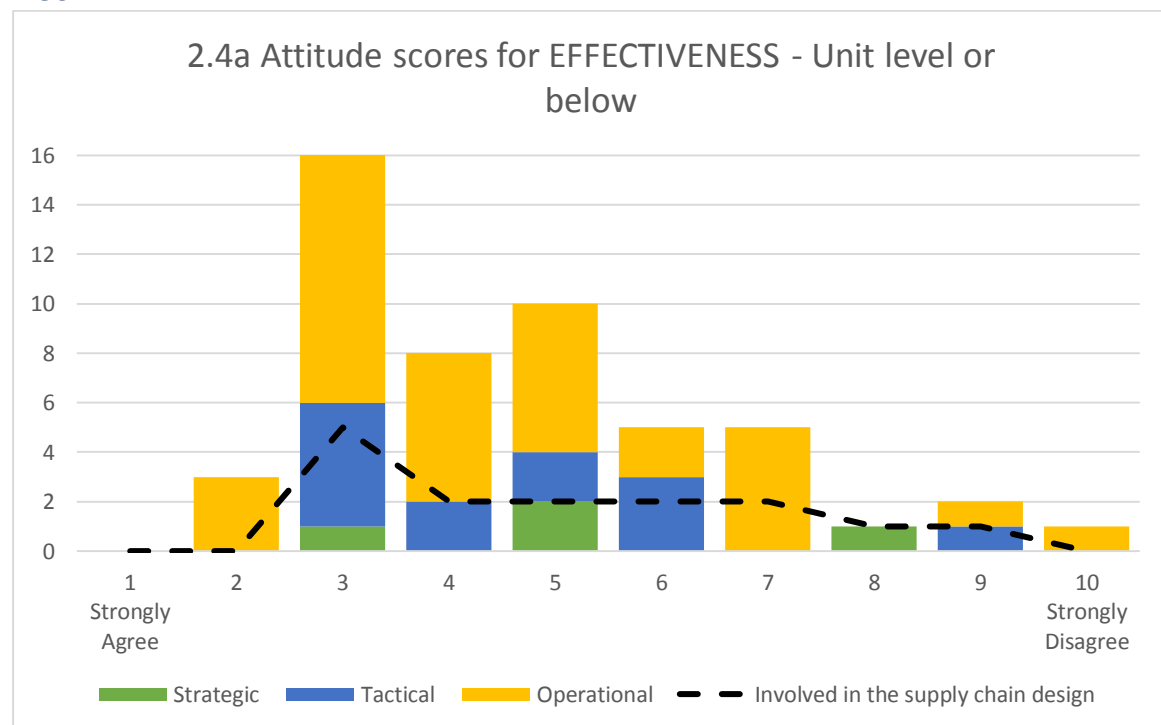


FIGURE V

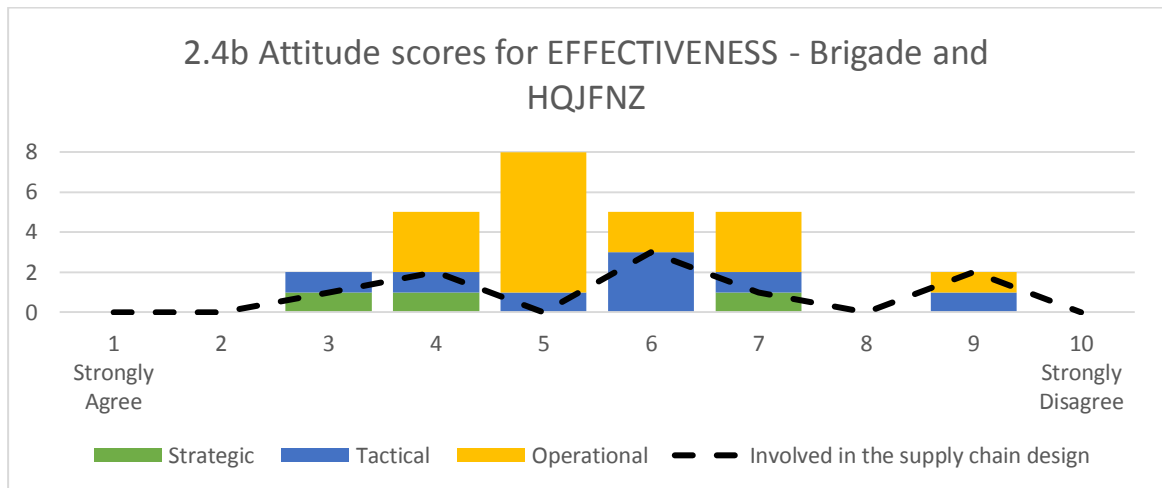


FIGURE VI

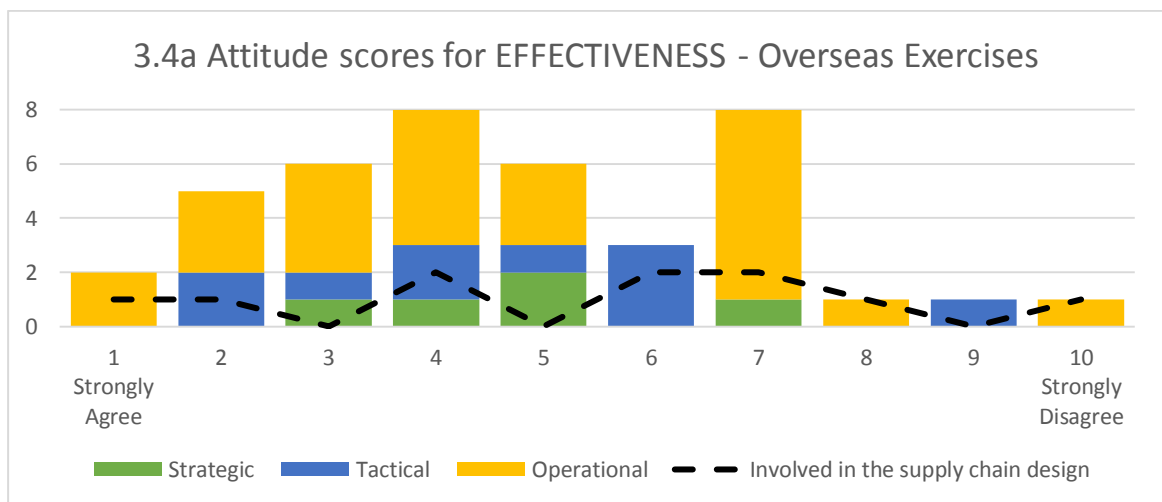


FIGURE VII

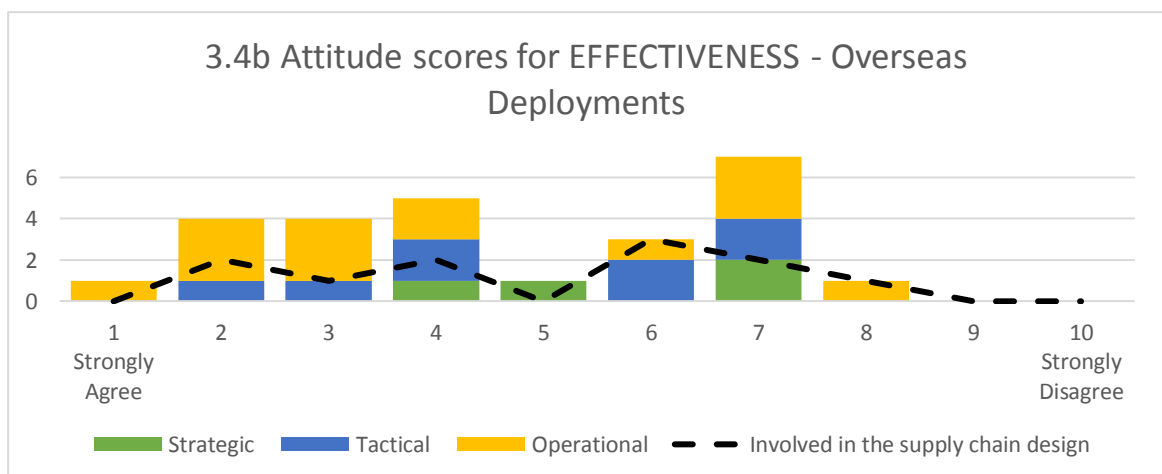


Table X

Efficiency												
The NZLAV supply chain, policies, and procedures were efficient in providing support for exercises or activities at the following levels:		Strongly Agree	Agree		Ambivalent	Neutral		Ambivalent	Disagree		Strongly Disagree	Activity response total
Survey Question	Activity Category	1	2	3	4	5	6	7	8	9	10	
2.5a	Unit level or below		3	14	11	9	5	4	2	3	1	52
2.5b	Brigade and HQJFNZ			3	4	4	6	5	4	1		27
3.5a	Overseas exercises	1	3	8	3	12	4	7		4	1	42
3.5b	Overseas deployments		2	3	3	7	1	7	1	2		26
Rating Total		1	8	28	21	32	16	23	7	10	2	
Percentage of strong views		69.81%			NIL				30.19%			

The following graphs display survey responses regarding efficiency for each activity category, grouped by respondents' management level. These graphs also show how many respondents for each attitude score (1 – 10) were involved in the design of the supply chain for that activity category.

FIGURE VIII

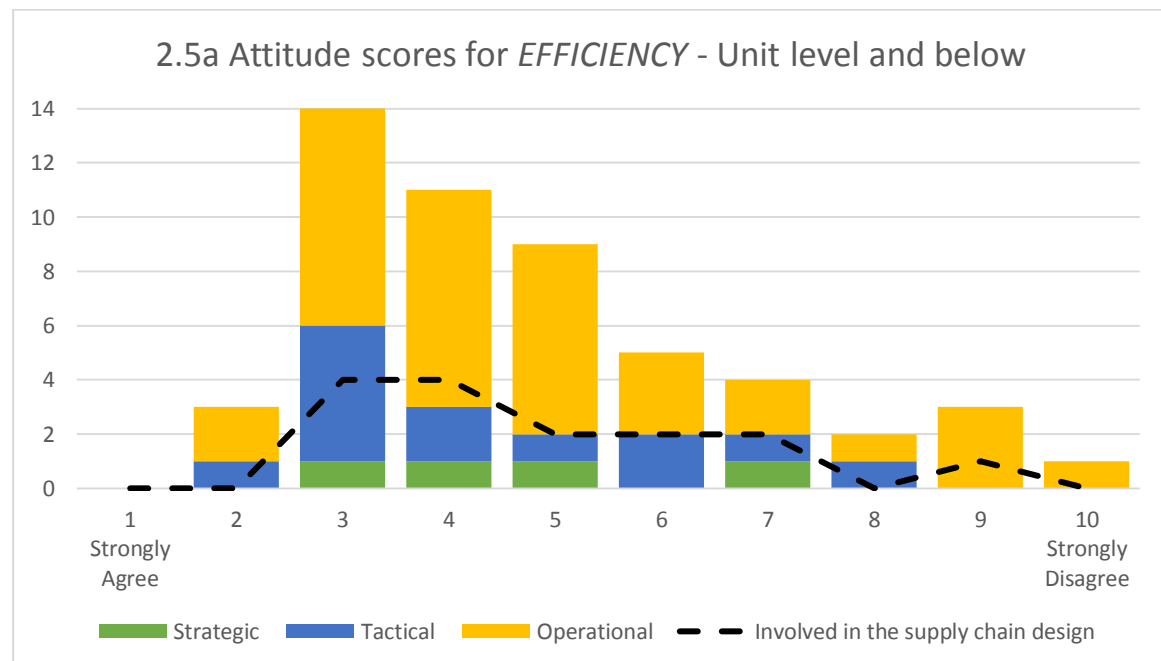


FIGURE IX

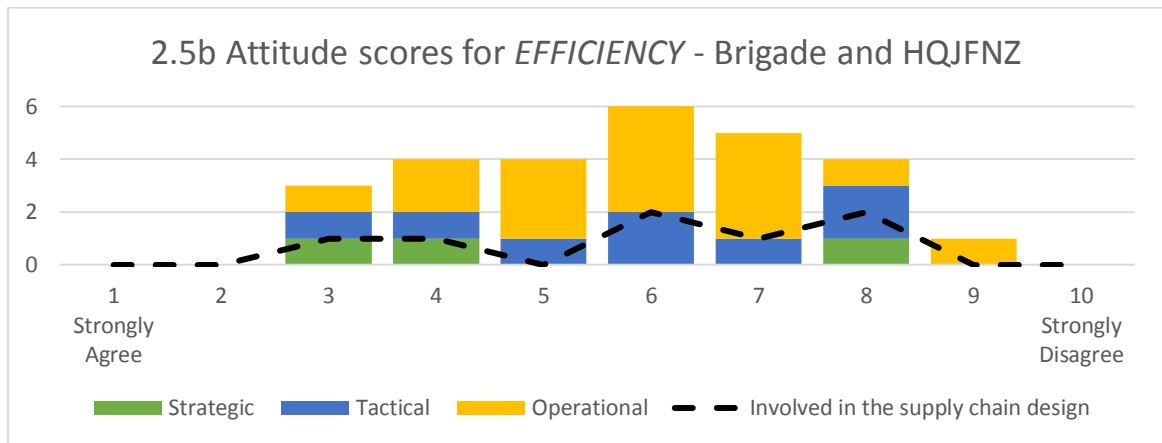


FIGURE X

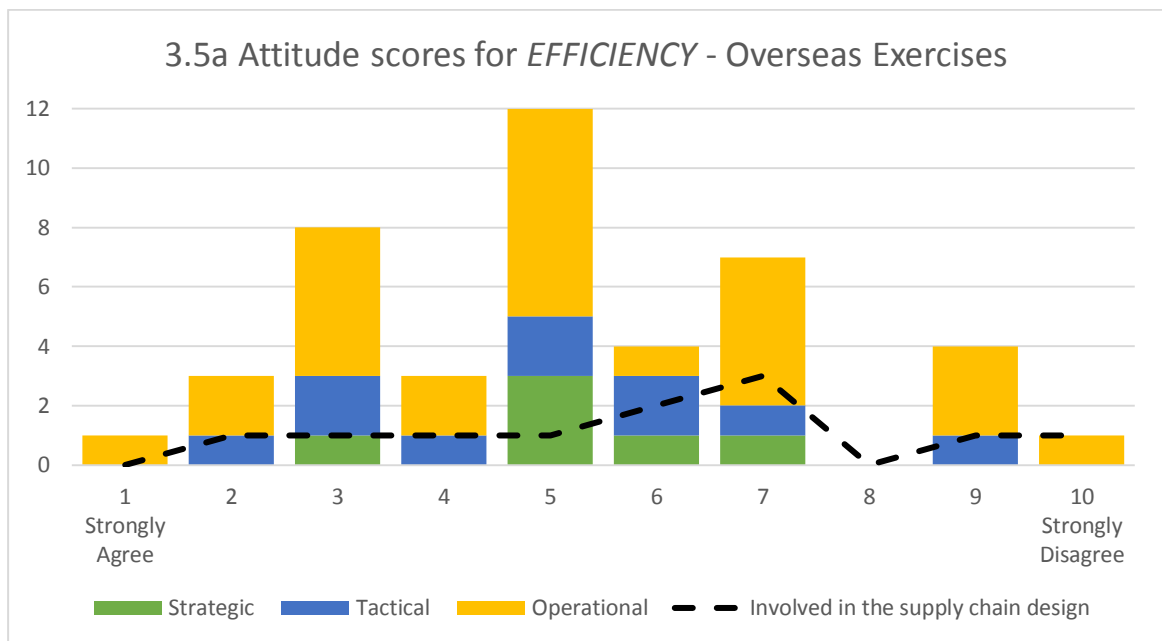


FIGURE XI

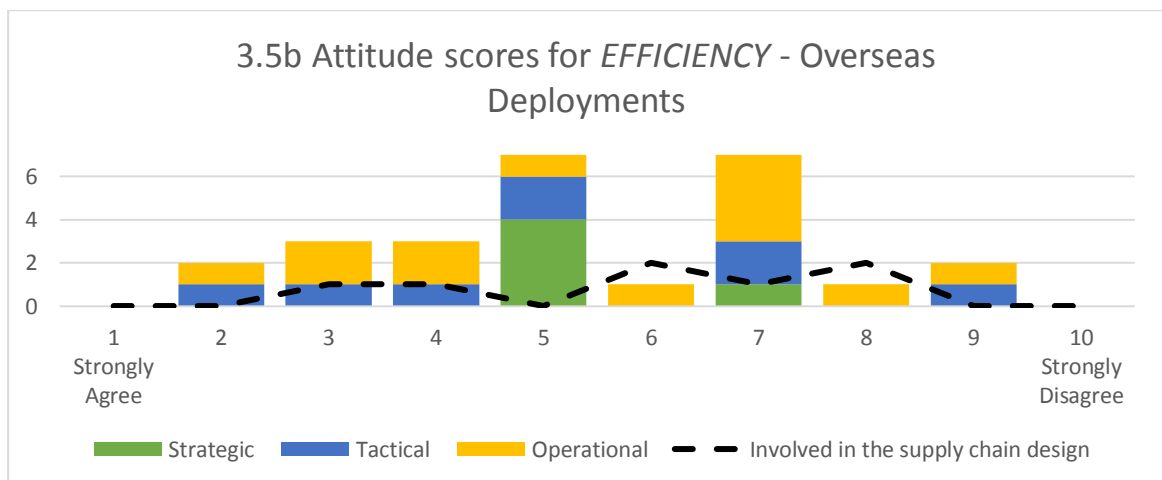


Table XI

Empowered to make improvements												
I felt empowered to make improvements to the NZLAV supply chain, policies, or procedures for exercises or activities at the following levels:		Strongly Agree	Agree		Ambivalent	Neutral		Ambivalent	Disagree		Strongly Disagree	Activity response total
Survey Question	Activity Category	1	2	3	4	5	6	7	8	9	10	
2.6a	Unit level or below		3	3	10	3	3	7	8	6	5	48
2.6b	Brigade and HQJFNZ		2	2	5	1	2	3	1	2	6	24
3.6a	Overseas exercises		1	2	3	6	3	6	4	1	12	38
3.6b	Overseas deployments		2		3	5	1	6	3	1	5	26
Rating Total			8	6	20	15	9	21	16	9	25	
Percentage of strong views			21.74%		NIL				78.26%			

The following graphs display survey responses regarding empowerment for each activity category, grouped by respondents' management level. These graphs also show how many respondents for each attitude score (1 – 10) were involved in the design of the supply chain for that activity category.

FIGURE XII

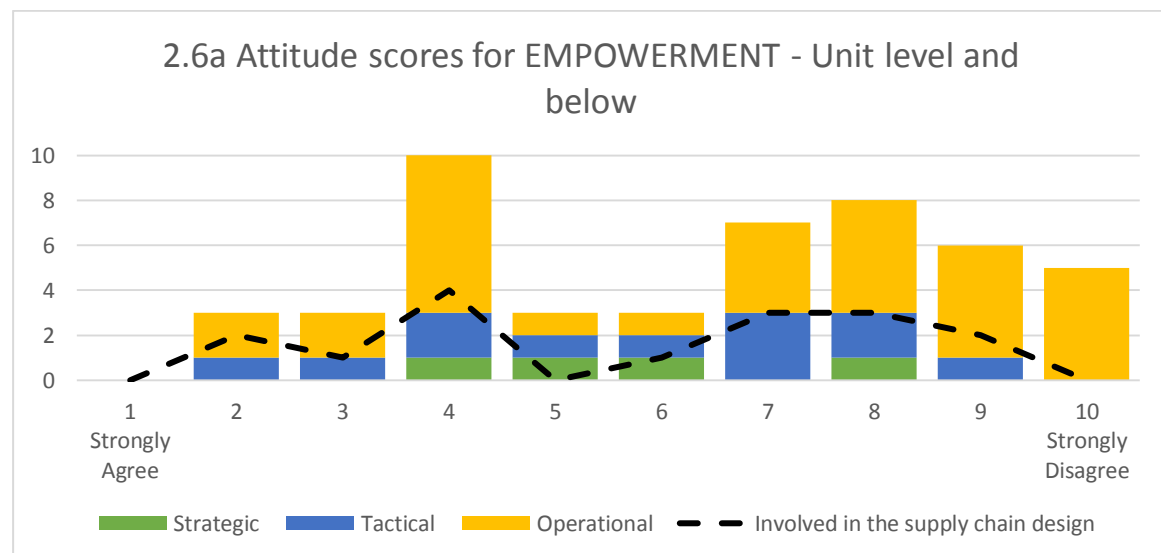


FIGURE XIII

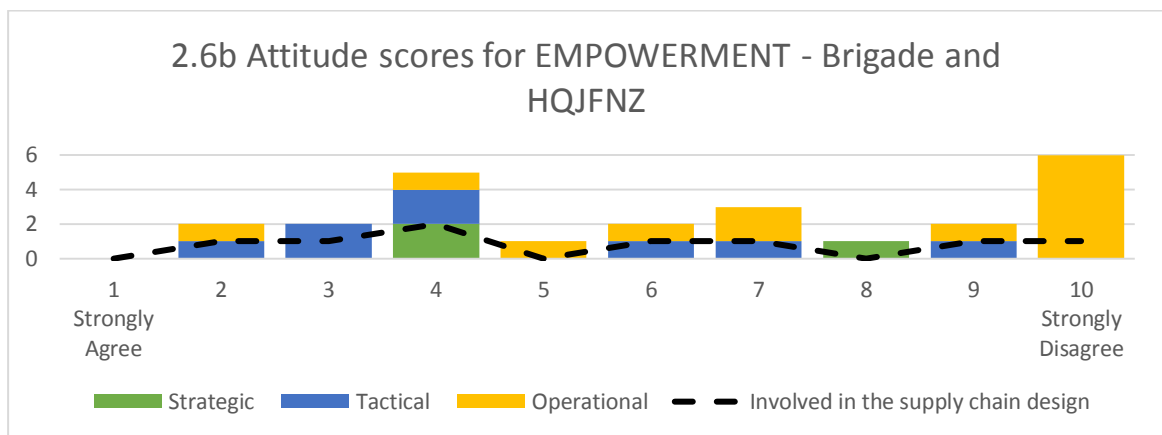


FIGURE XIV

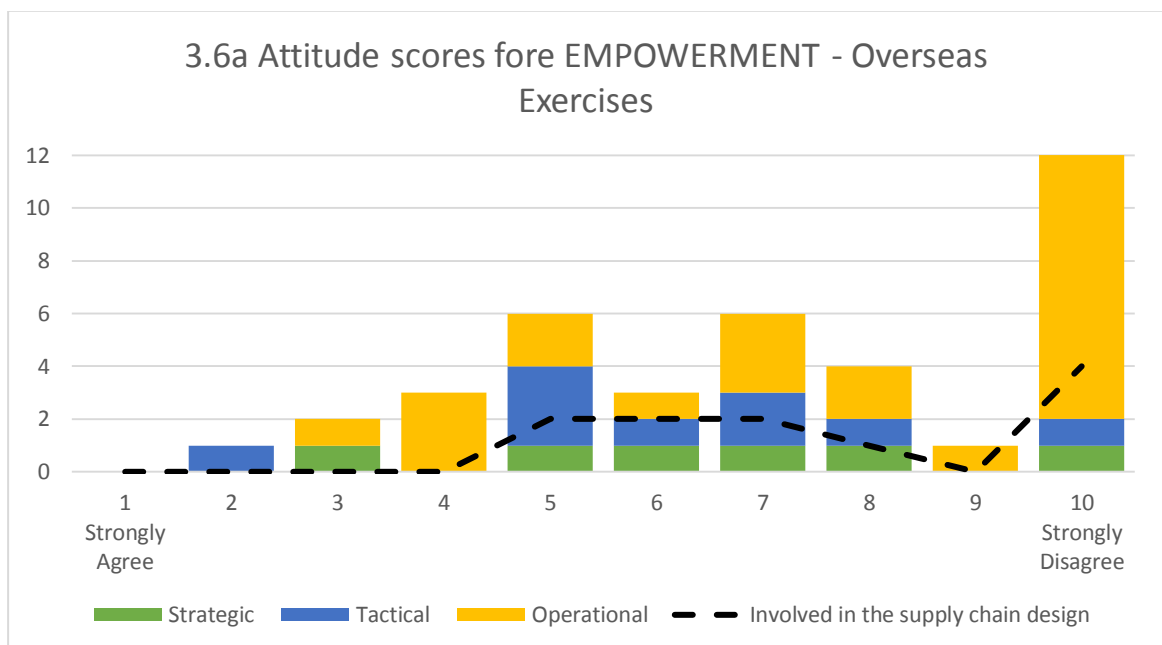


FIGURE XV

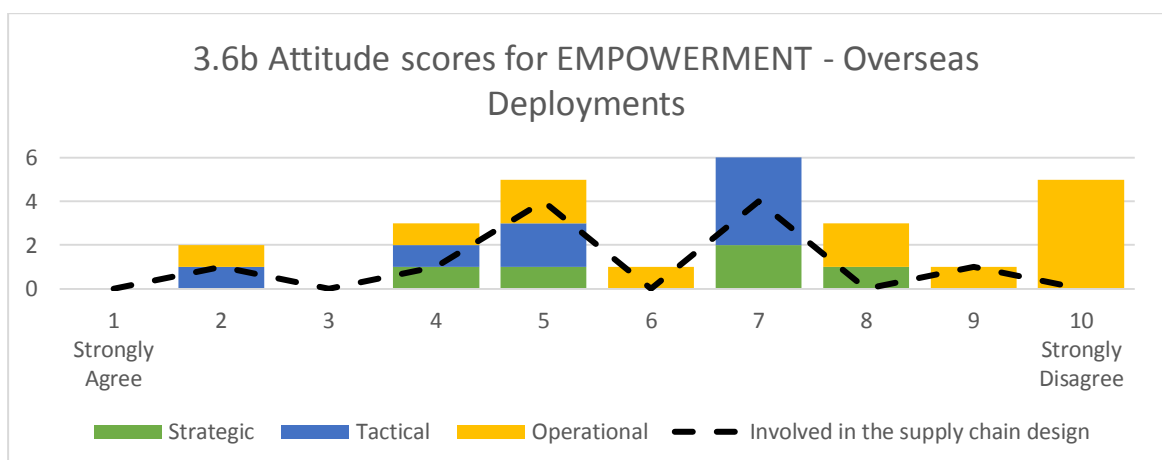


Table XII

Desire or need to operate outside prescribed system												
I did not need to (or wish to) operate outside of the prescribed NZLAV supply chain, policies, and procedures were effective in providing support for exercises or activities at the following levels:		Strongly Agree	Agree		Ambivalent	Neutral		Ambivalent	Disagree		Strongly Disagree	Activity response total
Survey Question	Activity Category	1	2	3	4	5	6	7	8	9	10	
2.7a	Unit level or below	3	10	7	4	6	7	4	3	2	3	46
2.7b	Brigade and HQJFNZ	1	1	5	4	1	4	1	3		3	22
3.7a	Overseas exercises	6	3	6	5	10		2	3	2	2	33
3.7b	Overseas deployments	4	1	3	2	6	4	1	2	1	1	21
Rating Total		14	15	21	15	23	15	8	11	5	9	
Percentage of strong views		66.67%			NIL			33.33%				

The following graphs display survey responses regarding the desire or need to operate outside the prescribed system for each activity category, grouped by respondents' management level. These graphs also show how many respondents for each attitude score (1 – 10) were involved in the design of the supply chain for that activity category.

FIGURE XVI

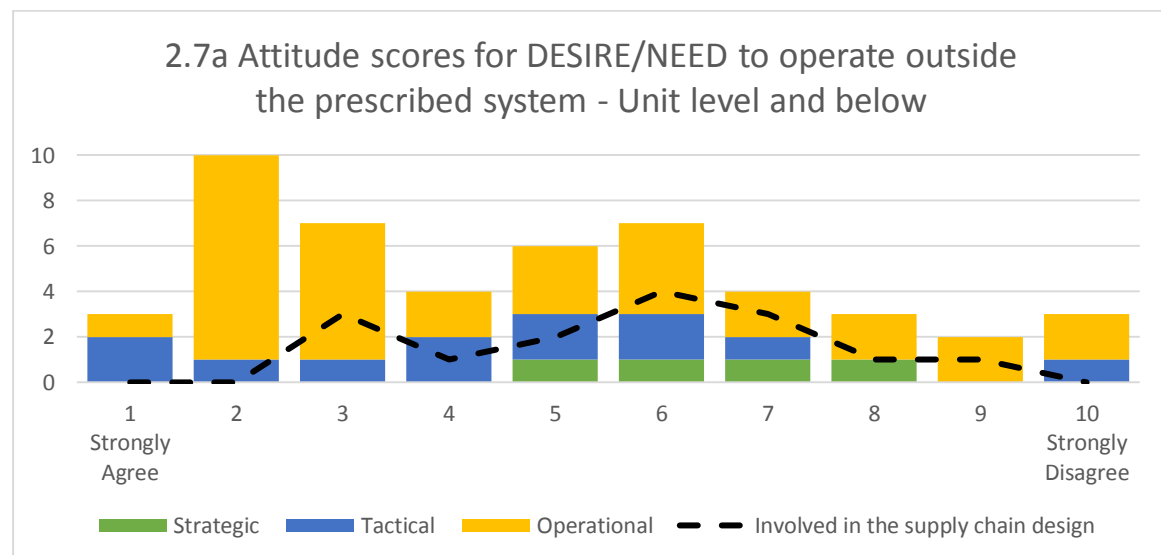


FIGURE XVII

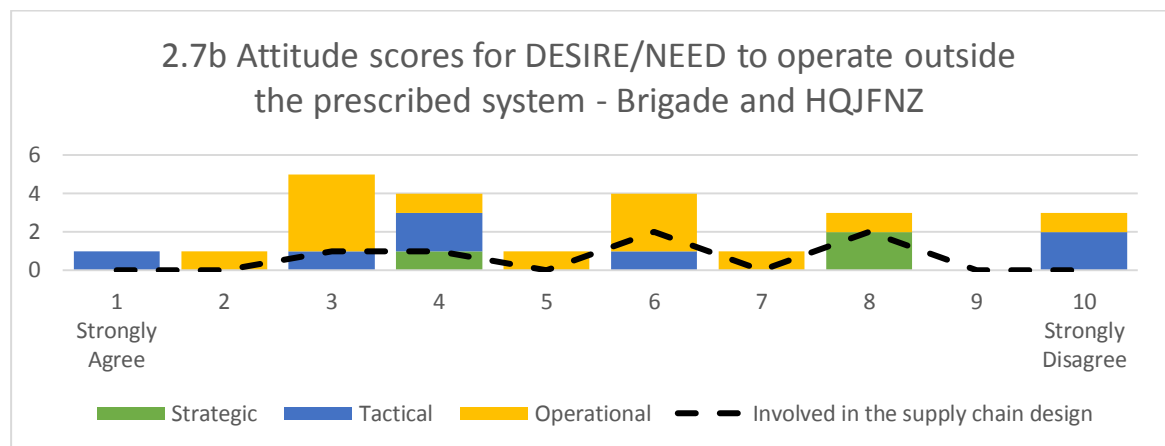


FIGURE XVIII

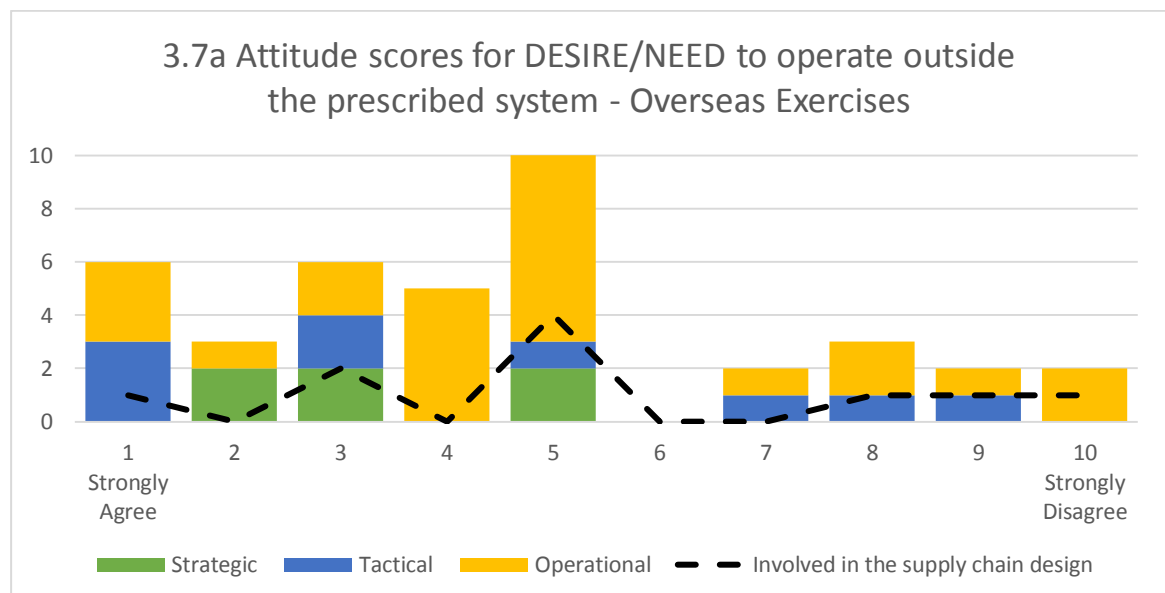


FIGURE XIX

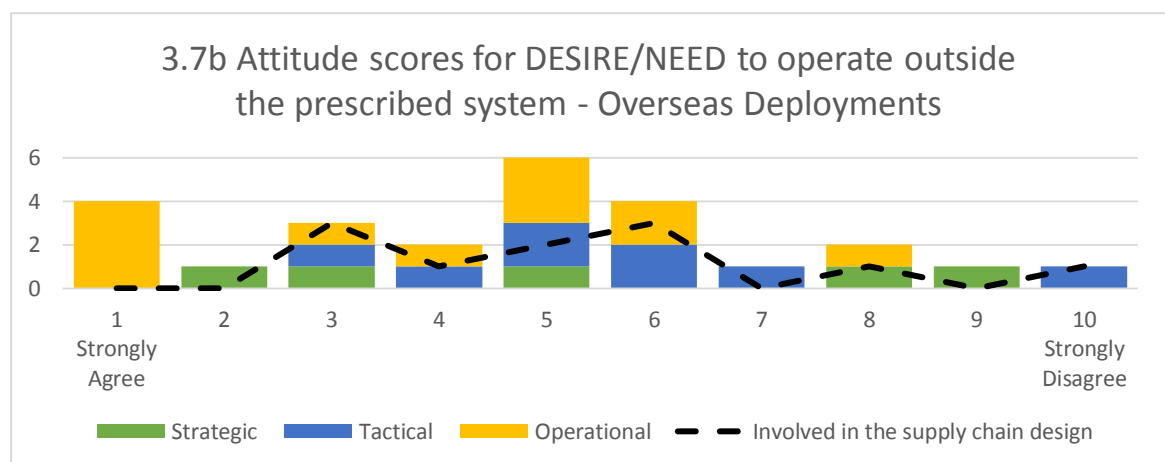
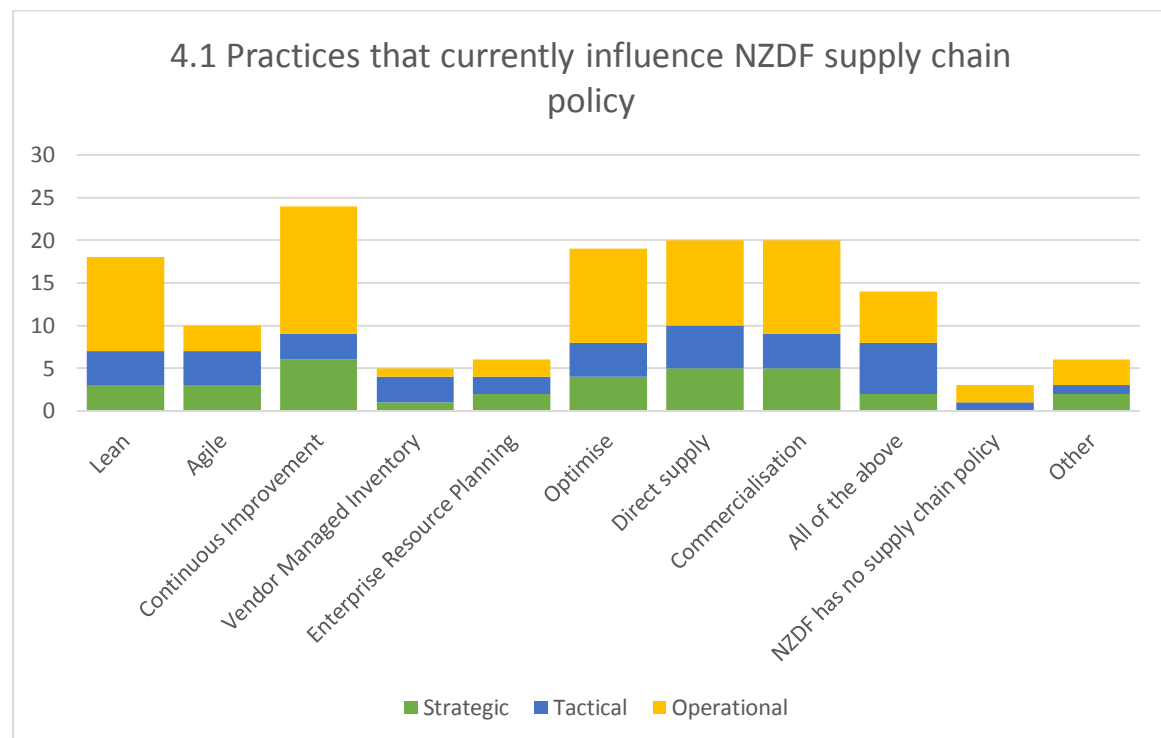


Table XIII

Survey Question 4.1 What supply chain theories, ideas, or best business practices currently influence NZDF supply chain policy?	
Theory, Idea, or Practice	Total Responses
Lean	32
Agile	24
Continuous Improvement	38
Vendor Managed Inventory	19
Enterprise Resource Planning	20
Optimisation of inventory holdings	33
Direct supply agreements	34
Commercialisation of NZDF	34
None – the NZDF does not have a supply chain policy	3
Other ²	6

FIGURE XX



² Four of the six responses for “other” were “I don’t know”. One respondent commented that the NZDF supply chain policy was influenced by the “Bro-net”. The “Bro-net” is the antonym of the “admin net”, which is a reference to the official process for demanding stores. The “Bro-net” is the unofficial process individuals will use to achieve success. The sixth respondent for “other” influence for NZDF supply chain policy commented that the influence was “poorly sited infrastructure and outdated procedures”.

Table XIV

Survey Question 4.2 What decisions are made or responsibilities currently exist at the following levels of command?												
Decision or Responsibility Description		Respondent's Management Level			Strategic			Tactical			Operational	
		Strategic	Tactical	Operational	Strategic	Tactical	Operational	Strategic	Tactical	Operational		
1	Establish policy	9	2	0	15	3	1	23	10	5		
2	Develops international agreements (Implementing Agreement, Memorandum of Understanding)	8	3	0	16	4	0	25	9	3		
3	Determine facility locations and capacities	8	4	1	14	9	3	21	12	6		
4	Determine the supply network	9	4	0	9	12	2	18	12	3		
5	Allocate funding and resources to meet need	8	3	2	12	6	2	15	14	8		
6	Establish procedures	6	6	4	5	13	7	9	15	13		
7	Determine inventory levels	9	4	3	8	14	4	10	15	14		
8	Selects prime vendors	9	1	0	12	8	0	17	13	5		
9	Establish procedures for procuring through international agreements	8	3	0	15	5	0	19	16	1		
10	Determine whether sole source, multi-source, or commercial off the shelf	9	2	0	14	7	0	17	11	3		
11	Determine lead time requirements	9	3	0	3	12	4	11	15	7		
12	Establish contracts with providers	9	2	1	11	9	1	19	17	6		
13	Determine how and when items move through the chain	8	6	3	4	13	8	11	19	9		
14	Determine what is classed as 1 st , 2 nd , 3 rd , 4 th line task	7	4	1	8	10	5	11	16	10		
15	Determine local purchase constraints	8	5	2	5	12	4	11	16	11		
16	Refine the plan to meet changing circumstances	7	7	6	4	14	8	15	13	15		
17	On time delivery of demands to customers	7	7	4	2	11	9	12	13	11		
18	Coordinate of the distribution network to respond to customers' demands	7	6	3	5	12	8	11	18	11		

Table XV

Survey Question 4.3 What decisions or responsibilities <i>should be</i> delegated to the following levels of command?												
Decision or Responsibility Description		Respondent's Management Level			Strategic			Tactical			Operational	
		Strategic	Tactical	Operational	Strategic	Tactical	Operational	Strategic	Tactical	Operational		
1	Establish policy	7	2	0	14	7	3	22	10	8		
2	Develops international agreements (Implementing Agreement, Memorandum of Understanding)	8	1	0	14	6	0	22	13	3		
3	Determine facility locations and capacities	6	6	2	9	13	7	13	22	14		
4	Determine the supply network	7	6	0	5	15	4	14	21	7		
5	Allocate funding and resources to meet need	7	4	1	14	8	2	23	16	5		
6	Establish procedures	6	6	3	5	14	10	17	20	19		
7	Determine inventory levels	7	5	3	5	11	11	11	20	16		
8	Selects prime vendors	8	1	0	9	11	2	21	19	8		
9	Establish procedures for procuring through international agreements	7	4	0	13	7	0	19	18	3		
10	Determine whether sole source, multi-source, or commercial off the shelf	8	1	0	10	13	1	18	21	6		
11	Determine lead time requirements	5	6	2	4	13	7	10	24	16		
12	Establish contracts with providers	8	4	1	10	11	4	22	19	9		
13	Determine how and when items move through the chain	6	7	3	2	14	6	13	19	15		
14	Determine what is classed as 1 st , 2 nd , 3 rd , 4 th line task	6	6	0	7	13	5	10	24	18		
15	Determine local purchase constraints	7	6	1	3	13	7	9	21	14		
16	Refine the plan to meet changing circumstances	6	6	6	7	13	11	13	21	25		
17	On time delivery of demands to customers	6	6	3	5	13	10	14	15	17		
18	Coordinate of the distribution network to respond to customers' demands	6	5	2	6	13	11	16	23	13		

FIGURE XXI

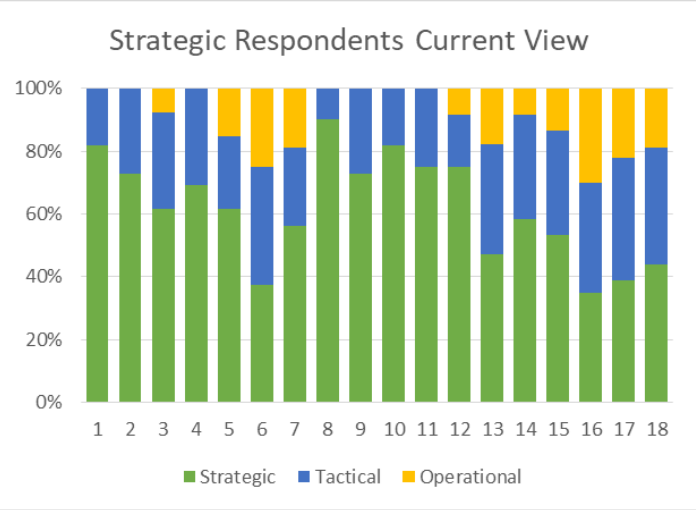


FIGURE XXIII

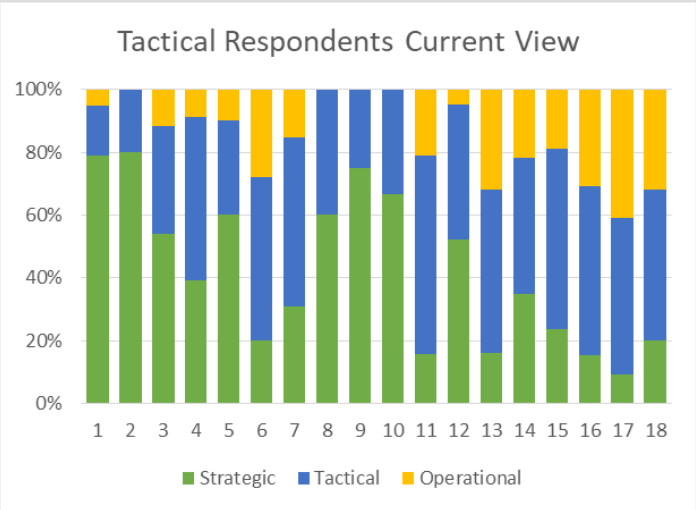


FIGURE XXV

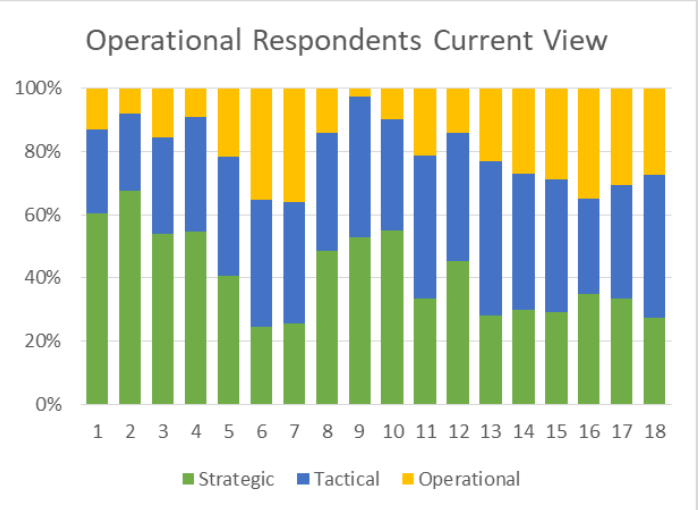


FIGURE XXII

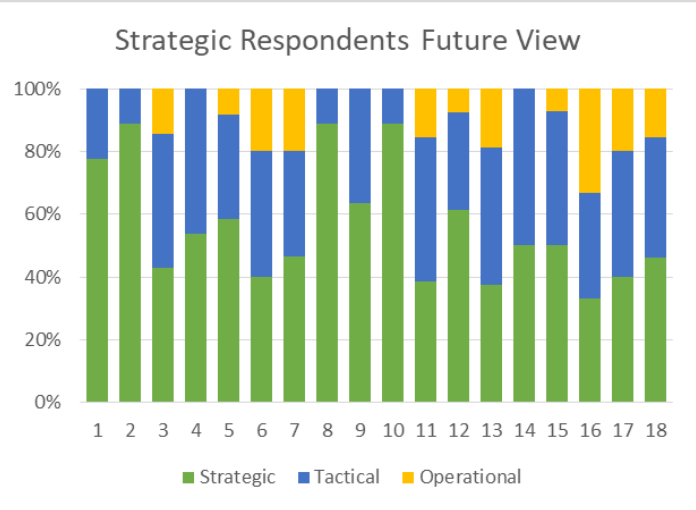


FIGURE XXIV

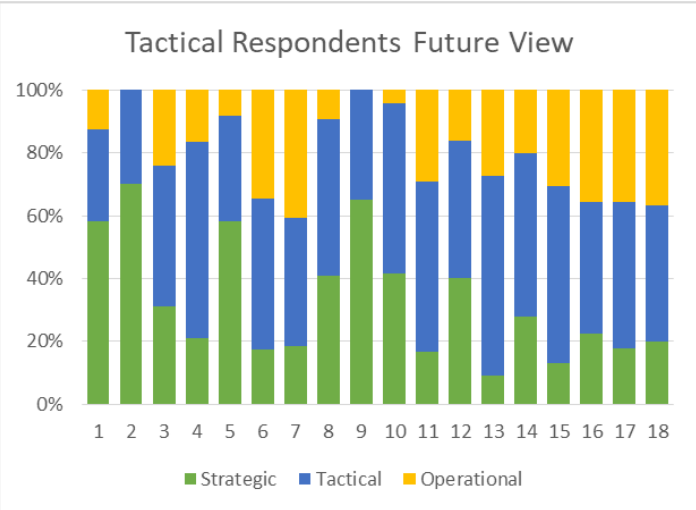


FIGURE XXVI

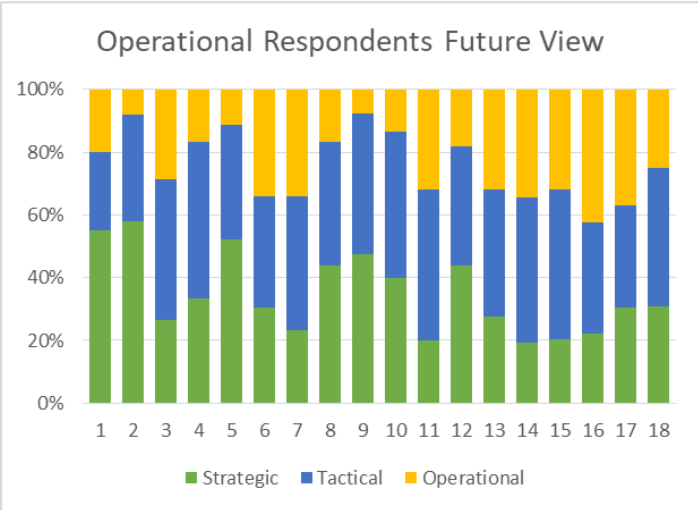


Table XVI

Comparison of current view and future opinion for allocation of supply chain decisions or responsibilities		Percentages for total responses					
		Current View			Future Opinion		
Decision or responsibility is or should be allocated to:		Strategic	Tactical	Operational	Strategic	Tactical	Operational
1	Establish policy	69.12%	22.06%	8.82%	58.90%	26.03%	15.07%
2	Develops international agreements (Implementing Agreement, Memorandum of Understanding)	72.06%	23.53%	4.41%	65.67%	29.85%	4.48%
3	Determine facility locations and capacities	55.13%	32.05%	12.82%	30.43%	44.57%	25.00%
4	Determine the supply network	52.17%	40.58%	7.25%	32.91%	53.16%	13.92%
5	Allocate funding and resources to meet need	50.00%	32.86%	17.14%	55.00%	35.00%	10.00%
6	Establish procedures	25.64%	43.59%	30.77%	28.00%	40.00%	32.00%
7	Determine inventory levels	33.33%	40.74%	25.93%	25.84%	40.45%	33.71%
8	Selects prime vendors	58.46%	33.85%	7.69%	48.10%	39.24%	12.66%
9	Establish procedures for procuring through international agreements	62.69%	35.82%	1.49%	54.93%	40.85%	4.23%
10	Determine whether sole source, multi-source, or commercial off the shelf	63.49%	31.75%	4.76%	46.15%	44.87%	8.97%
11	Determine lead time requirements	35.94%	46.88%	17.19%	21.84%	49.43%	28.74%
12	Establish contracts with providers	52.00%	37.33%	10.67%	45.45%	38.64%	15.91%
13	Determine how and when items move through the chain	28.40%	46.91%	24.69%	24.71%	47.06%	28.24%
14	Determine what is classed as 1 st , 2 nd , 3 rd , 4 th line task	36.11%	41.67%	22.22%	25.84%	48.31%	25.84%
15	Determine local purchase constraints	32.43%	44.59%	22.97%	23.46%	49.38%	27.16%
16	Refine the plan to meet changing circumstances	29.21%	38.20%	32.58%	24.07%	37.04%	38.89%
17	On time delivery of demands to customers	27.63%	40.79%	31.58%	28.09%	38.20%	33.71%
18	Coordinate of the distribution network to respond to customers’ demands	28.40%	44.44%	27.16%	29.47%	43.16%	27.37%

Table XVII

Survey Question 4.4 Does the NZDF delegate Responsibility, Accountability, and or Authority to act with respects to NZLAV supply chains to the following levels?			
Management Level	Responsibility	Accountability	Authority
Strategic to Tactical	39 (70.91%)	39 (70.91%)	32 (58.18%)
Tactical to Operational	39 (70.91%)	35 (63.64%)	29 (52.73%)

FIGURE XXVII

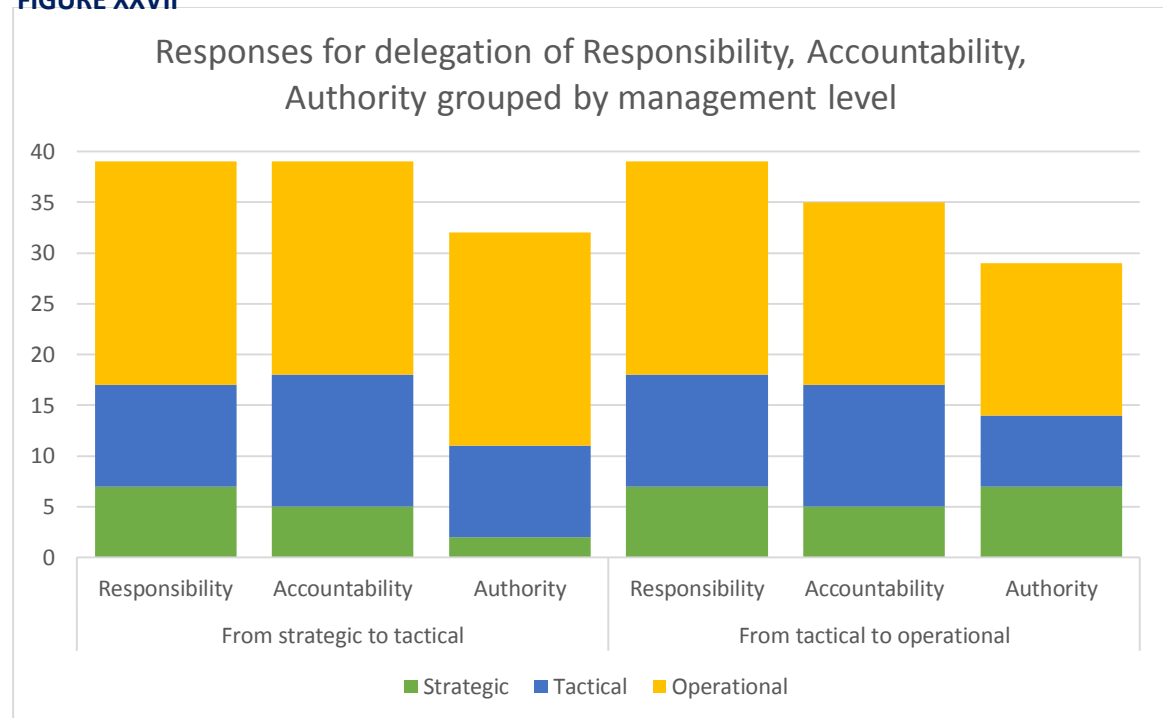


Table XVIII

Responses linking Responsibility, Accountability, and/or Authority			
Management Level	Responsibility with Accountability	Responsibility with Authority	Accountability with Authority
Strategic to Tactical	29 (52.73%)	23 (41.82%)	23 (41.82%)
Tactical to Operational	30 (54.55%)	20 (36.36%)	17 (30.91%)

Table XIX

Survey Question 4.5 Do strategic and tactical level commanders pay adequate attention to advice provided by operational commanders and LAV operators?		
Management Level of Respondents	Yes	No
Strategic level	4	5
Tactical level	5	10
Operational level	7	24
Total	16	39

Table XX

Responses to Survey Question 4.5 grouped by amount of experience within NZDF			
Years	Experience	Yes	No
1-5 years	Limited	0	6
6-20 years	Recent	5	25
21+ years	Considerable	11	8
Total		16	39

FIGURE XXVIII

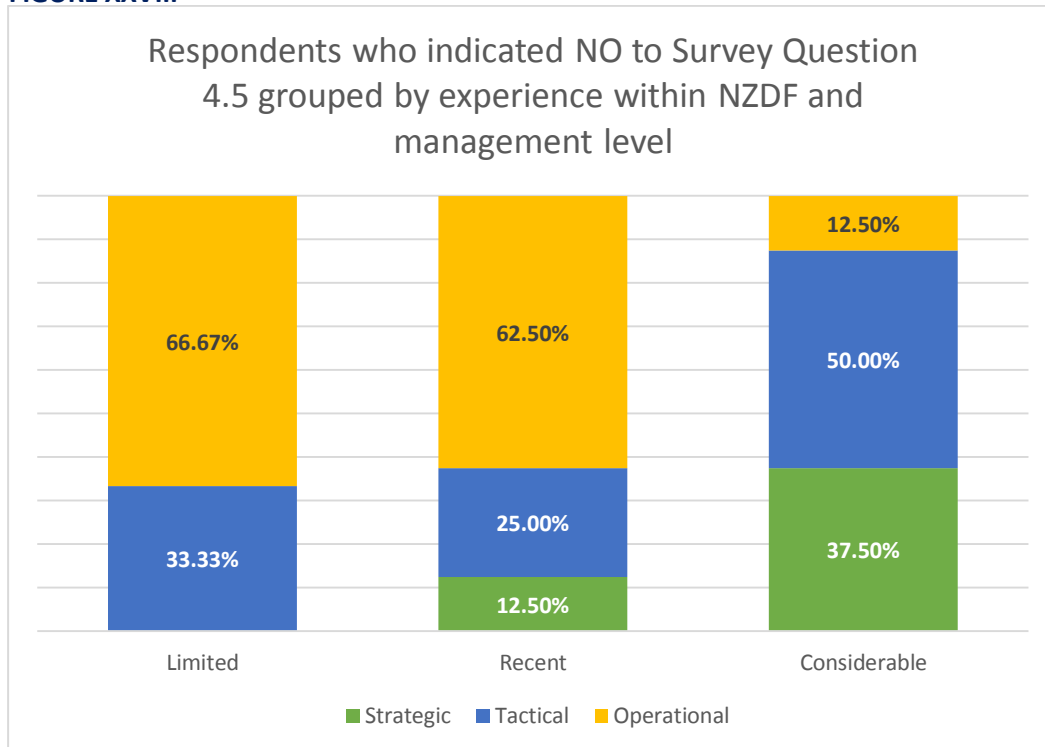


Table XXI

Responses to Survey Question 4.5 grouped by frequency of participation in activities		
Frequency	Yes	No
Once	2	3
Repeated participation in an activity category	14	36
Total	16	39

Annex G: Statistical Analysis of Survey Data

The survey data was collated and reviewed to ensure that a representative sample of the population had been obtained and that the results were statistically relevant. This allows the researcher to make valid conclusions applicable to the whole research population and inferences to be made regarding similar supply chain or management environments.

Annex G, Table 1 below provides the 'Descriptive Statistics' from Excel for survey responses. A normal distribution would be indicated by observations at or close to the mean occurring with the highest probability and decreasing progressively as observations deviate away from the mean with the standard deviation measuring the dispersion of the data in reference to the mean (Norušis, 2008). All the sample means are very close (between 0.08 and 0.77) to their respective medians. This indicates that the survey responses are reflective of a standard normal distribution. The kurtosis (how "peaked" results are around the mean) and skewness (left or right) are minimal, a further indication of a normal distribution. (Deviant, 2017)

Subsequent to considering the sample distribution a one sample 't-test' was completed on each relevant survey area to determine if the results were statistically significant (Norušis, 2008) (Nolan, 1994). The null hypothesis (H_0) for this 't-test' is that NZLAV supply chain attitudes will be positive, less than or equal to 4. The alternative hypothesis (H_A) is that the NZLAV supply chain attitudes will not be positive, greater than 4. Alpha (α) is set to 0.05 and hypothesised population mean (μ) is set to 4. Where the calculated 't-test' is greater than P the null hypothesis is rejected as the result is statistically significant. This can be written as:

H_0 : The NZLAV supply chain attitudes will be positive $\mu \leq 4$

H_A : The NZLAV supply chain attitudes will not be positive $\mu > 4$

Where $t > P$ reject H_0

Given the t-test results below it is possible to state, with a 95% confidence, that the difference between the sample mean and hypothesised mean are too great to be considered a random event and that this difference is also likely to occur in the population. The null hypothesis is rejected for these survey areas in favour of the alternative hypothesis. However this can only be stated for 13 of the 16 areas shown in the table, the other three areas (Questions 3.4b, 3.7a, and 3.7b) there is no statistical difference between the hypothesised mean and sample mean. For these three areas the null hypothesis is accepted.

The survey responses are a representative sample of the population and data is statistically relevant.

Annex G, Table 1: Descriptive statistics for survey questions

Survey Question ³ :	2.4a	2.4b	3.4a	3.4b	2.5a	2.5b	3.5a	3.5b	2.6a	2.6b	3.6a	3.6b	2.7a	2.7b	3.7a	3.7b
Mean	4.65	5.52	4.71	4.65	4.77	5.81	5.16	5.42	6.35	6.42	7.13	6.80	4.73	5.39	4.41	4.75
Standard Error	0.27	0.30	0.34	0.41	0.28	0.33	0.33	0.39	0.36	0.58	0.40	0.45	0.37	0.55	0.40	0.53
Median	4	5	4	4	4	6	5	5	7	6.5	7	7	5	5	4	5
Mode	3	5	4	7	3	6	5	5	4	10	10	7	2	3	5	5
Standard Deviation	1.92	1.55	2.18	2.10	2.00	1.71	2.17	1.98	2.46	2.86	2.47	2.27	2.60	2.66	2.59	2.57
Sample Variance	3.67	2.41	4.76	4.40	3.98	2.93	4.71	3.93	6.06	8.17	6.12	5.17	6.74	7.07	6.70	6.63
Kurtosis	0.33	0.16	-0.46	-1.41	0.09	-0.90	-0.41	-0.75	-1.22	-1.49	-1.12	-0.76	-0.79	-0.85	-0.39	-0.58
Skewness	0.90	0.56	0.33	-0.04	0.89	-0.09	0.32	0.02	-0.16	-0.02	-0.26	-0.10	0.45	0.40	0.61	0.17
Range	8	6	9	7	8	6	9	7	8	8	8	8	9	9	9	9
Minimum	2	3	1	1	2	3	1	2	2	2	2	2	1	1	1	1
Maximum	10	9	10	8	10	9	10	9	10	10	10	10	10	10	10	10
Sum	237	149	193	121	248	157	222	141	305	154	271	170	232	124	181	114
Count	51	27	41	26	52	27	43	26	48	24	38	25	49	23	41	24
Confidence Level (95.0%)	0.54	0.61	0.69	0.85	0.56	0.68	0.67	0.80	0.72	1.21	0.81	0.94	0.75	1.15	0.82	1.09
μ	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
t	2.41	5.08	2.08	1.59	2.78	5.51	3.51	3.66	6.62	4.14	7.81	6.16	1.98	2.51	1.03	1.43
α	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

³ Annex E details the survey questions in full.