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# **The Supply Chain in Air Capability Acquisition by the New Zealand Defence Force**

**A thesis presented in partial fulfilment of the  
requirements for the degree of**

Master of Arts in Defence and Security Studies at  
Massey University, Manawatū, New Zealand.

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## **Disclaimer**

The views, assumptions, thoughts and opinions expressed in this thesis are those of the author and do not necessarily reflect the official policy or position of the New Zealand Defence Force or any other agency of the New Zealand Government.

## Table of Contents

Disclaimer .....	ii
Table of Contents .....	iii
Abstract .....	v
Methodology .....	v
Ethics Approval .....	vi
Acronyms and Abbreviations .....	viii
Preface .....	xii
Acknowledgements .....	xii
List of Tables .....	xiii
List of Figures .....	xiii
Introduction .....	1
Chapter 1 – The Product and Capability Life Cycle in Defence Acquisition .....	10
Capability Life Cycle .....	15
NH90 Helicopter Acquisition .....	29
SH-2G(I) Super Seasprite Helicopter Acquisition .....	32
Chapter 2 – Sustainment of Defence Capability .....	39
Integrated Logistic Support .....	42
Paradigm Shift in Aeronautical Sustainment and Maintenance .....	47
The Royal New Zealand Air Force Supply Chain .....	52
Chapter 3 – Research Findings .....	56
Resources .....	59

Corporate Knowledge and Culture .....	63
Integrated Logistic Support .....	67
Product Maturity .....	73
Relationships.....	81
Chapter 4 – SWOT Analysis of Research Findings .....	85
Strengths (S) .....	89
Weakness (W).....	92
Opportunity (O).....	98
Threats (T).....	100
Conclusion .....	103
Bibliography .....	107
Appendix A .....	115
Thesis Research Methodology .....	115
Thesis Research Limitations.....	116

## **Abstract**

Over the last decade the New Zealand Government has acquired and introduced into operational service, two important platforms for air power capability, namely the new NH90, and SH-2G(I) Seasprite helicopters. The NH90 purchased new, and the Seasprite purchased second hand, are at different stages in their capability life cycles. The introductions of these aircraft have challenged support and sustainment within the Royal New Zealand Air Force (RNZAF) supply chain, which has been hampered by organisational factors such as the lack of capability and sustainment corporate knowledge, resource constraints, culture, and insufficient priority being given to Integrated Logistic Support (ILS) model In-Service. Equally aircraft specific issues such as their product maturity, and relationships also challenge the supply chain. The most significant level of aircraft acquisition is still yet to come as the Government progresses towards the replacement of the RNZAF surveillance and mobility capability. Therefore it is vital to understand the effect on support and sustainment from recent acquisitions.

## **Methodology**

Research for this thesis has been drawn from both primary and secondary sources. The acquisition of the NH90 and the Seasprite helicopters provides two case study examples of the effect that the acquisition has had on the RNZAF supply chain. The two case studies selected were appropriate because they were acquired and introduced into service over the last decade to meet capability outlined in Defence White Papers. While both were rotary in nature, each helicopter type was at a different maturity point in their product life cycle, which had a direct impact on supportability and sustainment. The collection of data from primary research was gathered from semi-structured interviews with eight (8) New Zealand Defence Force (NZDF) personnel who met predetermined participant qualification criteria. The interviews took one to two hours each and were conducted face to face with interviewees over who had to have first hand knowledge or experience in areas that included: customers or suppliers of the RNZAF supply chain; or knowledge and experience in the introduction-into-service of either or both of the NH90 and Seasprite helicopters; or knowledge and experience of sustaining either or both

platforms in-service. All interviews with personnel participating in the research remain anonymous, and have been cited in a professional and appropriate manner. Each participant has been allocated a letter of the alphabet, which has been referred to when referencing the interviews in the thesis.

The aim of the interviews was to gain insight from participant's knowledge and experience of sustaining the NH90 and Seasprite during their capability life cycles. Research was collected on a range of specific areas including the product and capability maturity in the life cycle, ILS across capability life cycles, Through Life Support (TLS) models and mechanisms, people and financial resourcing, supply chain management and reporting, technical influences, organisational and cultural factors, and training. Data was collected from the interview responses, and then codified and grouped into similar categories. Results of the findings are set out in Chapter 3, and the analysis is presented using a qualitative Strength, Weakness, Opportunity, and Threat (SWOT) analysis in Chapter 4. This approach to analysing the findings is a simplified process that allows qualitative primary research collected through this thesis to be distilled into core themes and be presented in such a way that is meaningful.<sup>1</sup> Secondary research was drawn from government reports, unclassified NZDF documents, scholarly articles, books, and reliable industry periodicals and publications, as well as other appropriate literature.

Appendix A provides further detail regarding the research methodology and limitations, during the completion of this thesis.

## **Ethics Approval**

Massey University Human Ethics Committee Southern B – 16/41 and the NZDF Organisational Research Unit have approved this research project and the methodology to obtain the research required to complete the thesis.

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<sup>1</sup> Marilyn M. Helms and Judy Nixon, "Exploring SWOT Analysis - Where Are We Now?: A Review of Academic Research from the Last Decade," *Journal of Strategy and Management* vol. 3, no. 3 (2010): 216, 29; Doug Leigh, "SWOT Analysis," in *Handbook of Human Performance Technology: Principles, Practices, and Potential*, ed. James A Pershing and Darlene M. Van Tiem (San Francisco, CA: Pfeiffer, 2006), 1050.





## **Acronyms and Abbreviations**

ADF	Australian Defence Force
ANAO	Australian National Audit Office
ANZAC	Australia, New Zealand Army Corps
ANZUS	Australia, New Zealand, United States
APIC	American Production Inventory Control society which merged with the Supply Chain Council and American Society of Transportation and Logistics
AUD	Australian Dollar
BBC	Better Business Case
CAF	Chief of Air Force
CapBr	Capability Branch
CIPS	Chartered Institute of Procurement and Supply
CMF	Capability Management Framework
CMP	Capability Management Plan
CMS	Capability Management System
CMSL	Capability Management System Lifecycle
CNS	Chief Of Naval Staff
CoA	Commonwealth of Australia
CoE	Centre of Expertise
DA	Defence Act 1990
DBC	Detailed Business Case
DCP	Defence Capability Plan
DCAP	Defence Capital Plan
DCCAP	Defence Capability Change Action Programme
Defence agencies	Ministry of Defence and New Zealand Defence Force
Defence	New Zealand Defence
Defence White Paper	New Zealand Defence White Paper 2016
DLC	Directorate of Logistic Command
DPEC	Directorate of Project Engineering and Certification

DWP	Defence White Paper
EASA	European Aviation Safety Agency
EDA	European Defence Agency
EMAR	European Military Airworthiness Requirements
ERT	European Resident Team
FOC	Final Operational Capability (German NH90s)
FOC	Final Operational Configuration (Finnish NH90s)
FST	Fleet Support Team
Government	New Zealand Government
IBC	Indicative Business Case
IIS	Introduction-Into-Service
ILS	Integrated Logistic Support
IOC	Initial Operational Capability (German NH90s)
IOC-	Initial Operational Configuration (Finnish NH90s)
IOC+	Nearly Operational Configuration (Finnish NH90s)
IPT	Integrated Project Team
Iroquois	Bell UH-1H Iroquois
IS	In-Service
ITAR	International Traffic and Arms Regulations
ITAS	Integrated Tactical Avionics System
LEP	Life Extension Programme
LCC	Life Cycle Costing
LFR	Logistic Field Representative
LRU	Line Replacement Unit
LUH	Light Utility Helicopter
MAWA	Military Airworthiness Authority Forum
MHC	Maritime Helicopter Capability
MHCP	Maritime Helicopter Capability Project
MPR	Major Project Reporting
MRH90	Multi Role Helicopter NH90 (Australian)
MSP	Managing Successful Programmes
MUH	Medium Utility Helicopter
NAHEMA	NATO Helicopter Management Agency

NATO	North Atlantic Treaty Organisation
NH90	NH Industries TNZA NH90 Helicopter
NHI	NH Industries
NZ variant	Kaman Aerospace SH-2G(NZ) Seasprite Helicopter (previously NZ variant sold to Peru)
NZD	New Zealand Dollar
NZDF	New Zealand Defence Force
OPC	Offshore Patrol Combatant
PIBC	Project Implementation Business Case
PRICIE	People, Research and Development, I, C, I, Equipment and Logistics
PRINCE2	Projects in a Controlled Environment
PuMP	Performance Measurement Process
RACI	Responsible, Accountable, Consult, and Inform
RAF	Royal Air Force
RAN	Royal Australian Navy
RNZAF	Royal New Zealand Air Force
RNZN	Royal New Zealand Navy
SB	Service Bulletin
SC	Supply Chain
SCMS	Supply Chain Management Squadron
SSCCs	Support System Constituent Capabilities
SCOR	Supply Chain Operational Reference
Seasprite	Kaman Aerospace SH-2G(I) Super Seasprite Helicopter
Super Seasprite	Kaman Aerospace SH-2G(A) Super Seasprite Helicopter (previously owned by Australia)
SWOT	Strength, Weakness, Opportunity and Threat
TLS	Through Life Support
TLM	Through Life Management
WoG	Whole of Government
WoLC	Whole of Life Cost
WW2	World War Two

UK	United Kingdom
US	United States of America
USG	US Government

## **Preface**

Over the past decade, a significant level of new and upgraded major RNZAF air capability has been acquired and introduced into the NZDF. These projects have included the acquisition and introduction of the NH90 and the second-hand upgraded Seasprite helicopter fleets. The maturity of the product along with introduction of these aircraft, as well as the ILS and sustainment initiatives, has had a direct flow on effect to the RNZAF supply chain. This thesis examines those effects on the supply chain from the introduction into operational service of these aircraft.

## **Acknowledgements**

The successful completion of this thesis would not have occurred without the substantial level of support and investment received from the NZDF, Massey University, family and friends, and colleagues. While too numerous to name all who have provided assistance, I would like to particularly acknowledge the significant help and guidance received from my thesis supervisors, Dr John Moremon and Dr Carl Bradley. Equally, the support and encouragement provided by Occupational Therapist Craig Gordon and Active + Co-Owner and Clinical Director/Senior Physiotherapist Kent Stenbridge, as well as my colleagues and superiors, Mike Going and Mark Stevens. My close friends and peer reviewers Pippa Barratt and Hans Van Leeuwen, along with the very precious love from my mum Shirley and sister Joanna, have been instrumental in the successful completion of this thesis. You all know how much you have helped me celebrate the wins and overcome the challenges on a journey of discovery to reach this key milestone, both professionally and personally, thank you all so much.

## List of Tables

Table 1 SWOT Analysis –NH90 and Seasprite supply chains.....	89
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## List of Figures

Figure 1 Product Life Cycle (based on Lee and Edwards’sinterpretation and adaption of Vernon’s Product Life Cycle Theory).....	12
Figure 2 Capability Management Framework (based on the Defence CMF).....	17
Figure 3 Capability Life Cycle (based on the Defence CMF) .....	19
Figure 4 Major Air Capability Life Cycle Transition from Acquisition to In-Service (based on the Defence CMF & RNZAF FST construct) .....	30
Figure 5 Key Difference Between UH-1H (Iroquois) vs NH90 Helicopter Fleet (based on Interviews & ANAO ‘Multi-Role Helicopter Programme’ Report) ...	31
Figure 6 Key Differences Between SH-2G(NZ)) vs SH-2G(I)) Helicopter Fleet (based on interviews & ANAO ‘Super Seasprite’ Report).....	35
Figure 7 RNZAF supply chain (based on Interviews).....	54
Figure 8 Lightning Strike Damage to NH90 .....	74
Figure 9 Key Findings.....	86

## Introduction

“Every hour of every day, 365 days a year, NZDF is contributing to the defence, security and well-being of Aotearoa/New Zealand”.

NZDF<sup>2</sup>

The primary role of the NZDF is to carry out military operations either independently, or within multi-national coalition environments alongside New Zealand’s security partners. The NZDF conducts a wide range of other vital Government tasking including the protection of New Zealand’s exclusive economic zone and maritime resources, search and rescue, and humanitarian aid and disaster relief in New Zealand and abroad. For the NZDF to be effective, the New Zealand Government needs to ensure the right military capability is acquired and sustained to carry out these roles.<sup>3</sup> The RNZAF performs an important part in enabling the NZDF to achieve Government tasking by fulfilling its mission of “carrying out military air operations to advance New Zealand’s security interests”.<sup>4</sup>

While small in size compared to other air forces, the RNZAF is equipped to carry out a number of principal roles. These include surveillance, strategic airlift, tactical airlift, and naval combat support.<sup>5</sup> The fleet of aircraft comprise of a number types and capabilities including the fixed wing transport and surveillance aircraft, multi-role helicopters, and pilot training aircraft. The RNZAF also supports and maintains the maritime helicopters integrated with Royal New Zealand Navy’s (RNZN) ANZAC frigates and Multi-Role Vessel.<sup>6</sup> Aircraft capability for the RNZAF

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<sup>2</sup> "Welcome to NZDF," New Zealand Defence Force, <http://www.nzdf.mil.nz/> (accessed 26 September, 2016).

<sup>3</sup> "Defence Capability Plan," (Wellington: Ministry of Defence, 2014), 8-9.

<sup>4</sup> "Air Force," Royal New Zealand Air Force, <http://www.airforce.mil.nz/about-us/> (accessed 28 September, 2016).RNZAF Mission Statement

<sup>5</sup> Ibid.

<sup>6</sup> Ibid.

continues to be acquired, upgraded and modified to meet current and future Government and Defence requirements.

The New Zealand Defence White Paper 2016 outlines the Government's strategic direction and future capability needs. Described as the combination of equipment, platforms, infrastructure and the people, capability is needed to perform its roles and tasks.<sup>7</sup> Aircraft capability typically has a long life cycle, and it is often complex and costly to both acquire and sustain once In-Service.<sup>8</sup> Peter Greener's ground breaking study of Defence acquisitions of the past, has demonstrated military capability has long been a matter of concern to New Zealand Defence agencies, albeit an area that tends to be little studied. Greener's work has advanced our knowledge on the topic and importantly it has also highlighted the issue of block obsolescence, illustrating how from past decision-making the New Zealand Government has found itself in a perpetuating cycle of having to replace multiple aircraft types at around the same time approximately every 30-40 years. In recent decades, the New Zealand Government has commissioned a number of Defence and capability reviews including Roderick Deane's "Value-For-Money" report submitted in 2010, which ultimately led to civilianising positions traditionally held by military personnel; the Strategos Review (1988), Hunn report (2002), and the Defence Procurement Review (2009), have all helped shape the governance of Defence,<sup>9</sup> and the creation of the Capability Management Framework (CMF) which governs the acquisition and management of Defence capability.<sup>10</sup> The Strategos Review, Hunn report and Defence Procurement Review, all recommended changes to Defence governance, acquisition procedure and culture in some form. The recurring themes included weaknesses in governance, relationships and delivery

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<sup>7</sup> "Defence White Paper 2016," (Wellington: Ministry of Defence, 2016), 45.

<sup>8</sup> "Integrated Logistics Support in Capability Management Handbook," ed. Directorate of Logistics Command Integrated Logistic Support Centre of Expertise (Wellington: New Zealand Defence Force, 2010), 5.

<sup>9</sup> "NZDF Strategy to Capability Capital Asset Management And Long - Term Capital Planning," ed. Tertiary Education Commission (Wellington: New Zealand Government), 8; "Capability Management Framework," (Wellington: Ministry of Defence; New Zealand Defence Force).

<sup>10</sup> "Background on Military Capability and the Evolution of the Defence Capability Management Framework," in *Foreign Affairs and Trade Committee: Briefing on major defence acquisition projects Project 1 – Ministry of Defence-New Zealand Defence Force Supp1 (Background on Military capability)* (Wellington: Ministry of Defence, 2009), 3-6.



of benefits as well as the fundamental requirement for an integrated and whole-of-life approach to managing capability across Defence, while also drawing attention to the need to be maximising leverage opportunities by establishing Through Life Support (TLS) arrangements across the Capability Life Cycle at the time of acquisition.<sup>11</sup>

Raymond Vernon, world-renowned economist and founder of the modern Product Life Cycle theory, provides the theoretical building blocks that underpin the Capability Life Cycle discussed throughout this thesis.<sup>12</sup> Alvin Lee and Mark Edwards describe a products interaction with consumers from the point of entry into the market and until it reaches maturity with the product then declining and becoming obsolete.<sup>13</sup> The transformation of a product across the life cycle helps demonstrate the concept of defence capability progressing from stage to stage across its life cycle.<sup>14</sup> As the product life cycles evolve and become more complex, so too do the supply chains that support them.<sup>15</sup> Antti Saaksvuori and Anselmi Immonen support a position that life cycles have become more reliant on entwined networks and relationships across multiple supply chains as manufacturers of technically complex and capital-intensive products are evolving.<sup>16</sup> When a military capability such as an aircraft and their associated equipment and systems, has a product life cycle of forty years or more, the importance of relationships becomes more significant.<sup>17</sup> Without the knowledge and the networking, Defence capability

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<sup>11</sup> "Review 09 - Procurement Process Review ", ed. Ministry of Defence (Released Under the Official Information Act: Aurecon New Zealand Limited, 2009), 12.

<sup>12</sup> Raymond Vernon, "International Investment and International Trade in the Product Cycle," *The Quarterly Journal of Economics* vol. 80, no. 2 (1966): 190.

<sup>13</sup> Alvin Lee and Mark G. Edwards, *Marketing Strategy: A Life-Cycle Approach* (Cambridge: Cambridge University Press, 2013). 166.

<sup>14</sup> "Capability Management Framework," 8.

<sup>15</sup> Raymond Vernon, "The Product Cycle Hypothesis in a New International Environment," *Oxford Bulletin of Economics and Statistics* vol. 41, no. 4 (1979): 258.

<sup>16</sup> Antti Saaksvuori and Anselmi Immonen, *Product Lifecycle Management*, Third Edition ed. (Verlag: Springer 2008). 111-22.; Sameer Kumar and William A. Krob, *Managing Product Life Cycle in a Supply Chain* (Springer Science + Business Media Inc., 2005). 1-10; Yvonne Ward, "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," in *UK Lean Aerospace Initiative* (University of Bath, 2006), 33.

<sup>17</sup> "Integrated Logistics Support in Capability Management Handbook," 5.

is more difficult to sustain<sup>18</sup> Added to this, manufacturers are boosting future revenue by modifying their support offerings by including 'one stop shop' support and sustainment options across the products life cycle.<sup>19</sup> However supply chains continue to be challenged by complexity of products that include software as well as mechanical and electronic componentry. This is due to rapid advances in technology, and the fact that product life cycles of these sub-assemblies will actually decrease at a component level thereby causing greater obsolescence issues that need to be considered and mitigated over the life of product or capability.<sup>20</sup> The NZDF is not immune to these external factors.

Paradigm shifts in sustainment concepts as well as sustainment frameworks are brought to light in Yvonne Ward and Andrew Graves study of Through Life Integrated Customer Solutions by Aerospace Manufacturers,<sup>21</sup> and Ward's study of Through Life Support in the UK aerospace industry.<sup>22</sup> Ward and Graves, both renowned for their studies in management and business, presented arguments that supported a number of important themes, which included the changing demographics of products and service types the customer wanted, that industry lacked common definitions for sustainment terminology, and the need to create long-term fiscal value for organisations within the aerospace industry.<sup>23</sup> Also important is James Jones's internationally recognised work in Integrated Logistic Support (ILS), a system of logistic elements that are integrated to support military capability. Systems engineer and academic, Jones provides detailed guidance to military organisations on why and the how defence forces should invest in and implement the systems-based ILS approach originally developed by the US military

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<sup>18</sup> Saaksvuori and Immonen, *Product Lifecycle Management*: 111-22.; Kumar and Krob, *Managing Product Life Cycle in a Supply Chain*: 1-10; Ward, "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," 33.

<sup>19</sup> Saaksvuori and Immonen, *Product Lifecycle Management*: 111-22.

<sup>20</sup> Ibid., 121.

<sup>21</sup> Yvonne Ward and Andrew Graves, "Through-Life Management: The Provision of Integrated Customer Solutions By Aerospace Manufacturers," in *School of Management Working Paper Series* (University of Bath, 2005), 6.

<sup>22</sup> Ward, "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," 2.

<sup>23</sup> Ibid.

to support and sustain defence capability.<sup>24</sup> ILS forms a key part of the Defence's doctrinal approach to sustaining major capability systems over their useful life.<sup>25</sup>

RNZAF aircraft are currently sustained through a Fleet Support Team (FST) construct, which crosses multiple command chains within the NZDF. Typically the teams will be aircraft type specific, and comprise supply chain and engineering personnel.<sup>26</sup> However, there is no one Command structure that is accountable for all aspects of ILS in the sustainment of aircraft capability.<sup>27</sup> It is important that organisations clearly define roles and responsibilities, and even more so in an organisation such as the NZDF where accountabilities and responsibilities are spread across a matrix style organisation containing multiple command lines across multiple functions.<sup>28</sup> The Responsible, Accountable, Consult and Inform (RACI) model provides a framework of identifying and empowering those responsible for doing the work, who is ultimately accountable for achieving the output, who needs to be consulted and kept informed.<sup>29</sup> The clear delineation between roles and responsibilities is important for the NZDF, and in particular within sustainment organisations because it reduces ambiguity and improves the effectiveness of the sustaining Defence capability. The roles and responsibilities of sustaining RNZAF aircraft is currently spread across NZDF Directorate of Logistics Command (DLC), which looks after integrated supply support and a portion of

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<sup>24</sup> James V. Jones, *Integrated Logistic Support Handbook*, Third ed. (New York: Sole Logistics Press McGraw-Hill, 2006). xiii.

<sup>25</sup> "ILS Framework Overview for Projects/Programmes Greater Than \$15m," ed. Defence Logistic Command (DLC) ILS Centre of Expertise (Wellington: New Zealand Defence Force, 2013), 11.

<sup>26</sup> G, Participant. "Supply Chain Study - Participant G." 1:13:41. Interview by Author. Sound Recording. RNZAF Base Ohakea, May 23, 2017; A, Participant. "Supply Chain Study - Participant A." 39:45. Interview by Author. Sound Recording. RNZAF Base Auckland, May 09, 2017.; C, Participant. "Supply Chain Study - Participant C." 1:35:14. Interview by Author. Sound Recording. RNZAF Base Auckland, May 11, 2017.; F, Participant. "Supply Chain Study - Participant F." 1:05:54. Interview by Author. Sound Recording. RNZAF Base Auckland, May 09, 2017.; E, Participant. "Supply Chain Study - Participant E." 1:07:56. Interview by Author. Sound Recording. RNZAF Base Ohakea, May 23, 2017.

<sup>27</sup> B, Participant. "Supply Chain Study - Participant B." 50:26. Interview by Author. Sound Recording. RNZAF Base Auckland, May 09, 2017.

<sup>28</sup> "Review of the Implementation of the Court of Inquiry's Recommendations Following the 2010 ANZAC Day Iroquois Crash," ed. State Services Commission (Wellington: Burleigh Evatt, 2012), 9, 22.

<sup>29</sup> Peter Bolstorff and Robert Rosenbaum, *Supply Chain Excellence a Handbook for Dramatic Improvement Using the SCOR Model*, Third Edition ed. (AMACOM-American Management Association, 2012). 150.

maintenance, while the Chief of Air Force (CAF) is responsible for engineering support and airworthiness.<sup>30</sup>

Over the last two decades, the RNZAF has been the recipient of a number of major acquisition programmes. Helicopter fleets including the RNZAF-maintained Naval Helicopter Force, were replaced to meet current and future capability requirements.<sup>31</sup> The requirement for fleet replacement was especially evident in the case of the Bell UH-1H Iroquois (Iroquois), which had been in operation since the 1960s and was coming to the end of its structural and economic life. In July 2006 the Government signed a contract with NH Industries (NHI) to purchase eight NH90 Medium Utility Helicopters and a spares package that included a spares attrition aircraft.<sup>32</sup> Meanwhile the RNZN was operating an old variant of the Seasprite helicopter known as the "NZ", which was also facing significant avionics obsolescence issues and scheduled for upgrade in 2015 due to its age. Keeping these aircraft up-to-date was a challenge given the small global fleet size of the Seasprite family of helicopters. Fortunately, the Government was offered a fleet of already upgraded second-hand SH-2G(A) Super Seasprite helicopters that had been previously owned by the Commonwealth of Australia. The package included ten helicopters, a full-mission flight simulator and synthetic training devices, and a software development environment.<sup>33</sup> The Government assessed the purchase of the package as low risk even though the Australians had experienced airworthiness and safety issues, which cleared the way for the acquisition to proceed.<sup>34</sup> In May 2013 a contract was signed with Kaman Aerospace for the purchase.<sup>35</sup>

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<sup>30</sup> C, 2017.; A, 2017.; E, 2017; G, 2017.; F, 2017.

<sup>31</sup> "Reporting the Progress of Defence Acquisition Projects," ed. Office of the Auditor General (Wellington: New Zealand Government, 2008), 37; "Naval Helicopter Replacement," Royal New Zealand Navy, <http://navy.mil.nz/mtf/fsac/naval-helicopter-replacement.htm> (accessed 18 February, 2018).

<sup>32</sup> "Reporting the Progress of Defence Acquisition Projects: Interim Report, June 2008," ed. Office of the Auditor-General New Zealand (Wellington: New Zealand Government, 2008), 37.

<sup>33</sup> "Naval Helicopter Replacement".

<sup>34</sup> Greg Little et al., "The Super Seasprite," ed. Australian National Audit Office (Canberra: Commonwealth of Australia, 2009), 15.

<sup>35</sup> "Major Projects Report 2013," (Wellington: Ministry of Defence, 2013), 163-66.

With the acquisition of these new aircraft, the RNZAF supply chain has faced a number of challenges supporting capability. The NZDF has been required to focus on fiscal and political pressures, cost cutting measures, caps on personnel numbers and implementing recommendations outlined in the 2010 Defence Value-For-Money report.<sup>36</sup> The perceived constant expectation on and within the NZDF to “Doing More with Less”,<sup>37</sup> lean resourcing, and a loss in depth of corporate knowledge, comes at a sustainment cost to maintaining military capability, while at the same time also creating undesirable human factors. Pressures in the RNZAF supply chain comes from increased sustainment costs, the lengthening of external repair cycle times, and pressures placed on limited pools of spares. Additionally, the generation gap in technology between old and new capability can be significant, which can also add to the complexity and resource requirements to sustain contemporary aircraft.<sup>38</sup> Mature or immature products reaching the end or beginning of their economic or useful lives add another layer of burden on supply chains maintaining and sourcing material, as they expend effort to overcome obsolescence.<sup>39</sup>

This is not the first time the NZDF has experienced challenges associated with major Defence acquisition programmes. Historically, the NZDF has been faced with significant ageing military equipment that has caused procurement challenges at intervals, particularly during the 1960s and again towards the end of the twentieth century. This has resulted in a tendency to carry out major acquisitions to modernise military capability within a condensed period of time.<sup>40</sup> Greener’s *Timing is Everything: The Politics and Processes of New Zealand Defence Acquisition*

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<sup>36</sup> Roderick Deane and Greg Kay, “Value for Money Review of the NZDF August 2010,” (Wellington: Pacific Road Group and Released Under the Official Information Act, 2010).

<sup>37</sup> “Statement of Intent 2011-2014,” ed. New Zealand Defence Force (Wellington: New Zealand Defence Force, 2011), 38; “Performance Improvement Framework: Review of the New Zealand Defence Force (NZDF) September 2015,” (Wellington: State Services Commission, The Treasury, and the Department of the Prime Minister and Cabinet, 2015), 9; “New Zealand Defence Force: Progress With the Defence Sustainability Initiative,” (Wellington: Office of the Auditor-General, 2009), 35.

<sup>38</sup> “New Zealand: New Helicopters Represent a Quantum Leap Forward,” *US Fed News Service, Including US State News* 2006, 5 1.

<sup>39</sup> C, 2017.; G, 2017.

<sup>40</sup> Peter Greener, *Timing is Everything: The Politics and Processes of New Zealand Defence Acquisition Decision Making* (Canberra: ANU E Press, 2009). xix.

*Decision Making*, provides an in-depth look at a number of major air acquisition case studies between 1984 and 2001, including the first Seasprite naval helicopter programme.<sup>41</sup> While Greener's work has been important for advancing the knowledge of Defence acquisition in New Zealand, it does not specifically address support and sustainment aspects at a RNZAF supply chain level.

This thesis aims to examine the supply chain in air capability acquisition by the NZDF. With little published material on supply chain effects of introducing air power capability, the thesis makes considerable use of interviews conducted with personnel within the NZDF. This thesis introduces a number of key findings relating to the RNZAF supply chain using lessons from the introduction of the NH90 and Seasprite. While Chapters 1 and 2 introduce the key concepts and considerations of the Product Life Cycle and the ensuing linkage to the acquisition and sustainment of aircraft capability, Chapter 3 brings together the key findings from the interviews conducted. Drawing on these findings, in Chapter 4 Strength, Weakness, Opportunity and Threat (SWOT) analysis has been carried out to discuss the key findings.<sup>42</sup> By carrying out the SWOT analysis, findings such as resourcing, corporate knowledge, culture, ILS, product maturity, relationships, and their effect on the RNZAF supply chain is better understood.

It should be noted that the complexities and challenges of introducing new military capability are not unique to New Zealand. Australia and other countries too are experiencing maintenance and sustainment issues. Australia has faced many challenges in maintaining and sustaining their MRH90 (the Australian variant of the NH90)<sup>43</sup> The MRH90 project presented a number of challenges such as issues surrounding the maturity of the design, maintainability and reliability, burgeoning sustainment cost, as well as contract performance concerns.<sup>44</sup> Finland and the Netherlands too have experienced similar frustrations with the NH90 aircraft

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<sup>41</sup> Ibid.

<sup>42</sup> Helms and Nixon, "Exploring SWOT Analysis - Where Are We Now?: A Review of Academic Research from the Last Decade," 216, 29; Leigh, "SWOT Analysis," 1050.

<sup>43</sup> MRH90 is a multi-role variant of the NH90 helicopter type

<sup>44</sup> Raymond McNally, Natasha Linard, and Stuart Turnbull, "Multi-Role Helicopter Program," ed. Australia National Audit Office (Canberra Commonwealth of Australia, 2014), 15.

design, contract performance, and In-Service sustainment issues.<sup>45</sup> In the case of Australia's introduction of the SH-2G(A) helicopters into operational service, this project too presented significant challenges. Unease arising from safety concerns, project complexity and risk, cost overruns, aircraft delivery delays, and an increasing apprehension that the helicopter may not meet the intended operational requirements. In the end, the issues were too much for the Australian's to accept and they cancelled the project in 2008.<sup>46</sup> Like New Zealand and a number of other nations have experienced, introducing new aircraft is a complex and a tough exercise that brings with it many challenges.

The New Zealand Government finds itself once again on the verge of major capability system procurement with P-32K surveillance and C130LEP mobility aircraft fast approaching the end of their operational and structural lives. With significant investment required, political pressures and public interest in outcomes, a through life approach to sustaining the new aircraft, plus understanding how the introduction will effect the supply chain that supports aircraft, is essential. Using the lessons learned from introducing the NH90 and Seasprite, serious consideration must be given to these past experiences to better understand the first, second and third order of effects discussed in this thesis. If this does not occur and the root causes addressed adequately in time for the next round of major capability acquisitions, then effects will become repetitious and plague the NZDF for years to come.

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<sup>45</sup> Keijo Suila, "Finland's Helicopter Program," ed. Ministry of Defence (Finland: Ministry of Defence, 2008), 8; "Helicopter Corrosion Maintenance Prediction Using Environmental Sensors," (Amsterdam: Defence Material Organisation, 2015), 7-8.

<sup>46</sup> Little et al., "The Super Seasprite," 24.

## **Chapter 1 – The Product and Capability Life Cycle in Defence Acquisition**

“Warfare is the greatest affair of state, the basis of life and death, the way to survival or to extinction and therefore must be thoroughly pondered and analysed”.

Sun Tzu<sup>47</sup>

Product Life Cycle theory is the academic foundation that underpins the thesis and is key to understanding the effects on the supply chain when introducing new military capability. The Product Life Cycle is a theoretical economic business model that has transformed international trade and business thinking, and provides academic reinforcement to the military Capability Life Cycle. Developed by Raymond Vernon following WW2, economists of the mid-twentieth century were debating various theories behind emerging clarity in the US ‘labour to capital’ ratios in the production of goods for domestic and international markets. The catalyst for shaping a paradigm shift in economists’ critical thinking, came in the 1960s with the emergence of Vernon’s revolutionary theory. The roots of the theory emerged from his empirical studies of organisational activities in global and multinational economics, trade and business. Vernon hypothesised that “new products constantly appear, then mature, and eventually die”.<sup>48</sup> This was a concept that would directly influence organisations’ contemporary strategic decisions on which product or capability to acquire, and how to support that product or capability over the product’s lifecycle. Vernon also proposed that there needed to be a consideration of additional economic variables such as “innovation, scale,

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<sup>47</sup> Sun Tzu, *Art of War: translated. with a Historical Introduction* trans. Ralph D. Sawyer (Colorado: Waterview Press, 1994). 167.

<sup>48</sup> Vernon, "The Product Cycle Hypothesis in a New International Environment," 255.



ignorance, and uncertainty”,<sup>49</sup> all factors that were often neglected in mainstream economic and trade theory during that time.

The Product Life Cycle provides a mechanism to articulate a shift in trends within consumer buying behaviour, and the influence of product evolution and market development.<sup>50</sup> Vernon purports that his theory reflects a complex framework of intertwined variables and factors that influence international trade and investment over the life of a product. Rather than focusing on cost comparisons as key drivers of trade, he instead suggested a greater emphasis needed to be placed on the “timing of innovation, the effects of scale economies, and the roles of ignorance and uncertainty”.<sup>51</sup> The foundation of his theoretical model is premised on four key areas and highlighted in Figure 1. Firstly, the Location of ‘New Product’ is where a new product is created and produced.<sup>52</sup> Secondly, the ‘Maturing Product’, which is when customer demand for a product intensifies, with Vernon hypothesising that there would be a degree of standardisation in that kind of product.<sup>53</sup> Thirdly, the ‘Standardised Product’, which considers products that have significantly matured and therefore have been standardised to a marked degree, and lastly, the product will overtime decline as it becomes obsolete.<sup>54</sup>

Today the theory behind the Product Life Cycle has become a fundamental aspect in business. In-depth analysis and understanding of the theory has been critical to the strategic success of global trade and investment decisions for many international organisations.<sup>55</sup> Although Vernon’s theory has evolved through academic refinement and application to different types of industries, it remains the theoretical core of life cycle methodologies applied across a breadth of industry, categories and individual products. Nowadays there are many variations of the Product Life Cycle model but generally they have remained true to the core, with

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<sup>49</sup> "International Investment and International Trade in the Product Cycle," 191.

<sup>50</sup> Lee and Edwards, *Marketing Strategy: A Life-Cycle Approach*: 167.

<sup>51</sup> Vernon, "International Investment and International Trade in the Product Cycle," 190.

<sup>52</sup> *Ibid.*, 191.

<sup>53</sup> *Ibid.*, 196.

<sup>54</sup> *Ibid.*, 202.

<sup>55</sup> Ronald S. Tibben-Lembke, "Life after death: Reverse logistics and the product life cycle," *International Journal of Physical Distribution & Logistics Management* vol. 32, no. 3/4 (2002): 226.

variations such as Introduction, Growth, Maturity and Decline phases also highlighted in Figure 1 below.<sup>56</sup> Vernon's model was the first of its kind to consider the impact of positioning mature products in new international markets, and has morphed into strategic product diversification.<sup>57</sup> Lee and Edwards infer that the essence of the Vernon's Product Life Cycle phases outlined in Figure 1, comes simply from a product that is released into a new market for consumption and then as consumer demand expands, so does manufacturing capacity increase in order to meet that demand. Over time, the new market reaches a saturation point flagging to the market that the product is reaching, or has reached maturity.<sup>58</sup> At this milestone, it is expected that the manufacturer will have developed mature technical and specialised knowledge along with localised labour skills sets, in order to produce a quality standardised product in the cheapest way. The product along with its manufacturing process is then at a stage where it can be exported to a second 'new or less developed' market, and then to a third market, and so on.<sup>59</sup> This creates diversification and dynamic competitive advantage derived from 'product and innovation' until such time the product becomes obsolete and is withdrawn from a single or multiple markets.<sup>60</sup>



**Figure 1 Product Life Cycle (based on Lee and Edwards's<sup>61</sup> interpretation and adaption of Vernon's Product Life Cycle Theory<sup>62</sup>)**

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<sup>56</sup> Vernon, "International Investment and International Trade in the Product Cycle," 191, 96, 202; Tibben-Lembke, "Life after death: Reverse logistics and the product life cycle," 227.

<sup>57</sup> Lee and Edwards, *Marketing Strategy: A Life-Cycle Approach*: 166.

<sup>58</sup> Ibid.

<sup>59</sup> Vernon, "The Product Cycle Hypothesis in a New International Environment," 263, 65-66.

<sup>60</sup> Lee and Edwards, *Marketing Strategy: A Life-Cycle Approach*: 171.

<sup>61</sup> Ibid., 166.

Product Life Cycle theory is applicable across multiple levels within economics and business. Higuchi and Troutt describe Product Life Cycle theory as a model that can, and is generally applied across three tiers. Firstly, across an entire industry, and secondly at a sub-category level within that industry, then lastly at an individual product level within that industry.<sup>63</sup> The success (or failure) of a manufacturer's production and life cycle diversification strategies are significant. The outcomes of product strategies directly impact brand, relationships, the end-to-end process of manufacturing products and distributing them to the market, along with the 'reverse logistics' that goes hand in hand with these strategies. For example and for the sake of simplicity, where a new electronics product is released to the market, if the customer is satisfied with the features and quality, along with having a positive buying experience, which includes packaging with simple to use instructions, plus after market through life support, the customer is less likely return the product at the onset<sup>64</sup>. This in turn reinforces a positive image of a manufactures brand and fosters successful organisational and business relationships. Reverse logistics is important too because it is solely focussed on the return of products and materials for the purpose of repairing or renewing the item to a serviceable state.<sup>65</sup> For example, in the case of the RNZAF the supply chain, aeronautical product is returned back to the original equipment manufacturer (OEM), or third party organisation for maintenance, repair or overhaul.<sup>66</sup> This function is usually carried out utilising the supplier's reverse logistics.<sup>67</sup>

Technology and innovation plays a significant role in the life cycle of a product. Categorised in three types, technology and innovation is pivotal to the product life cycle organisational strategy employed in a market. Firstly, an innovative product is released to a new market to solve a current problem. Secondly, on-going product improvements then occurs over time on that product and released to the market as

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<sup>62</sup> Vernon, "International Investment and International Trade in the Product Cycle," 190.

<sup>63</sup> Toru Higuchi and Marvin Troutt, *Life Cycle Management in Supply Chains: Identifying Innovation Through the Case of the VCR* (Hershey, New York: IGI Publishing, 2008). 12.

<sup>64</sup> Tibben-Lembke, "Life after death: Reverse logistics and the product life cycle," 227.

<sup>65</sup> Ibid., 224.

<sup>66</sup> C, 2017; G, 2017.

<sup>67</sup> Lee and Edwards, *Marketing Strategy: A Life-Cycle Approach*: 171-72.

the next generation or new version to keep pace with technology advances, which in turn may also extend the products life cycle. The third type is continuous innovation where products are re-engineered or new models with additional features are released to the market.<sup>68</sup> The speed at which product moves through phases of the life cycle is directly influenced by a number of factors including technology advances, customer requirements, and market changes over time along with the uniqueness of the industry.<sup>69</sup> 'Product and market pioneers' create new categories of product or markets. This is often driven by 'start-ups', and those expanding market share through sub-level markets, which in turn influences the length of the product life cycle. 'Late movers' usually enter the market at a later stage after waiting for the pioneers to carry out most of the research and development, and for the market to mature. Because consumer wants and needs usually change over time, producing viable products cheaper and more efficiently are possible during this period while learning from the mistakes of others.<sup>70</sup> A manufacturer's understanding of their product offering to a new market is key to how their organisation will or should engage with that market.<sup>71</sup> In a perfect world, an organisation should be highly familiar with their product. This simply means that an organisation will typically have an 'in-house development programme', typically own the intellectual property, and is pro-actively developing the market and the technology in that product. The manufacturer would make the best use of resources and share risk, and marketing and manufacturing objectives may be secured through joint ventures and branded product-licensing initiatives.<sup>72</sup>

Not all products are available to all markets.<sup>73</sup> In the case of new, improved and re-engineered specialist military products, these are generally only available to military organisations (such as the NZDF). Military products are heavily controlled

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<sup>68</sup> Ibid., 177.

<sup>69</sup> Ibid., 167.

<sup>70</sup> Ibid., 178-81.

<sup>71</sup> Ibid., 175.

<sup>72</sup> Ibid., 175-77.

<sup>73</sup> Higuchi and Troutt, *Life Cycle Management in Supply Chains: Identifying Innovation Through the Case of the VCR*: 14.

through country-to-country global export controls,<sup>74</sup> such as the American International Traffic and Arms Regulations (ITAR).<sup>75</sup> The purpose of ITAR is to strictly control how military technology is procured, transferred and used and against whom. Export controls authorise only certain countries to use that military product or capability. For example, because the Seasprite helicopter is manufactured in the USA and it is a military specific aircraft, the ownership and use of the capability must comply with ITAR. This meant that the New Zealand Government could not procure and take delivery of the helicopters from Kaman Aerospace until the US State Department had approved the transaction. Compliance with ITAR also applies in the sustainment of the Seasprite with most ILS arrangements sourced outside of the USA needing to be approved. Approval to procure, transfer and operate ITAR controlled capability is dependent on the origin of the product, the nature and stability of the countries to which the product is to be exported, their connections to undesirable organisations (such as terrorists groups), and whether there are any United Nations or sovereign sanctions in place.<sup>76</sup>

### **Capability Life Cycle**

Contemporary military capability acquisition and sustainment programs have been influenced by New Zealand's political history. Defence policy has been significantly shaped by a series of historic decisions mostly dating to the 1980s when the current Capability Management Framework (CMF) was brought to bear. Firstly and fundamentally, New Zealand implemented an anti-nuclear policy with the election of Labour in 1984. This prevented nuclear-powered US Navy warships from entering port. As a result, the United States initiated military sanctions, leaving New Zealand 'out in the cold' and effectively isolated from the long-standing ANZUS (Australia, New Zealand, and United States) Security Treaty.<sup>77</sup>

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<sup>74</sup> C, 2017; G, 2017.

<sup>75</sup> *The International Traffic in Arms Regulations (ITAR): 22 C.F.R. Chapter 1, Subchapter M Parts 120-130* (Washington DC: Society for International Affairs, 2016), 2.

<sup>76</sup> Ibid.

<sup>77</sup> Greener, *Timing is Everything: The Politics and Processes of New Zealand Defence Acquisition Decision Making*: 10.

Secondly, while relationships were estranged with the United States, New Zealand sought closer ties with Australia in the form of a collaborative ANZAC Frigate naval programme. Procuring two of ten ANZAC Frigates for the RNZN demonstrated the Government's commitment to the Trans-Tasman defence relationship, and also allowed New Zealand access to Australian defence contracts, which had been historically denied.<sup>78</sup>

Concurrent to foreign policy changes, the Labour government of the 1980s also faced significant fiscal pressures. The Lange government ploughed ahead with hierarchical changes to government agencies, and was clinical in its approach. Firstly the State Services became State Corporations with the State Owned Enterprise Act 1988 making these corporations formally answerable to a Minister to ensure the delivery of pre-determined annual outputs to Government. Then in return, the Treasury funded that corporation annually to deliver the agreed levels of output.<sup>79</sup> Secondly, one of the keystone tenants that underpinned the Government's philosophy was the need for delineation between policy and procurement decision, therefore this was taken away from the organisations that carried out the day-to-day running of the public service entity.<sup>80</sup> Lastly, the heads of those organisations could no longer have permanency in their roles; instead, they would only be employed for a fixed period of time.<sup>81</sup> Like many other public services, Defence capability acquisition and sustainment was targeted for reform.<sup>82</sup>

New Zealand Defence agencies are required to adhere to the CMF as it provides the official, authoritative and legislative basis to capability procurement and through life management across Defence. The CMF is an interconnecting system of artefacts and policy, governing how New Zealand Defence agencies deliver current and

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<sup>78</sup> Derek Quigley, "The Evolution of Defence Policy," *Security Challenges* vol. 2, no. 3 (2006): 43.

<sup>79</sup> "Chapter 8: Age of reform: 1984-1998," in *100 Years of Public Service: A Centenary Celebration of New Zealand State Services Commission Souvenir Booklet 2013* (Wellington: State Services Commission, 2013), 22.

<sup>80</sup> Greener, *Timing is Everything: The Politics and Processes of New Zealand Defence Acquisition Decision Making*: 15.

<sup>81</sup> "Chapter 8: Age of reform: 1984-1998," 22.

<sup>82</sup> Quigley, "The Evolution of Defence Policy," 43.

future capability to the New Zealand Government.<sup>83</sup> Defence capability and procurement reviews such as the Strategos and Hunn Reports, and the Defence Procurement Review (discussed in later paragraphs) have moulded the shape and reach of that framework into what it is today. The framework was originally built in the 1990s and comprises four key components: the Defence Act 1990, the current Defence White Paper, Capability Plan, and Capital Plan<sup>84</sup> (see Figure 2). The Defence Act 1990 provides the legislative foundation that underpins the CMF and outlines the responsibilities for both the MoD and NZDF.<sup>85</sup> The Defence White Paper outlines a 25-year strategic Defence roadmap, and is released approximately every five years. Whereas the Defence Capability Plan flags to the New Zealand public, security partners, and the defence industry the intent regarding current and future capability requirements.<sup>86</sup> The Defence Capital Plan provides a forecast of capital expenditure requirements out to 2035, to enable Government to deliver the initiatives set out in the Defence Capability Plan.<sup>87</sup>



Figure 2 Capability Management Framework (based on the Defence CMF)

The CMF also guides decisions across the military Capability Life Cycle. Comprising six major phases, the cycle includes Strategy and Policy, Capability Definition, Acquisition, Introduction-Into-Service, In-Service, and Disposal (see Figure 3).<sup>88</sup> Like Vernon’s product life cycle stages, the Capability Life Cycle correlates to the Product Life Cycle as Defence capability is developed, enters production, ages and

<sup>83</sup> "Capability Management Framework," 4-5.

<sup>84</sup> Ibid., 4.

<sup>85</sup> "Defence Act 1990," in *no. 28*, ed. New Zealand Government (Wellington 2014), 15.

<sup>86</sup> "Capability Management Framework," 8.

<sup>87</sup> Ibid.

<sup>88</sup> Ibid.

then becomes obsolete towards the end of its useful life.<sup>89</sup> There are minor differences in the terminology between the two life cycles, however the underlying concepts are similar to each of the Capability Life Cycle phases. The capability stages are also broken down to include and align with the Government's Better Business Case framework, and augmented by the endorsed "Managing Successful Programmes and Projects in a Controlled Environment (PRINCE2)", which is a project management methodology.<sup>90</sup> The purpose of the business case framework is to enable robust, 'value-for-money', publically funded capital asset acquisition decisions.<sup>91</sup>

The Capability Life Cycle comprises six phases. Strategy and Policy is the first phase, which encompasses Government strategic direction contained in the Defence White Paper, and includes capability and portfolio planning. The second phase, Capability Definition, includes the development of strategic investment logic map including Whole of Life Costing (WoLC), benefit analysis, and resource requirements to bring the capability acquisition or disposal programme to bear.<sup>92</sup> During this phase, the project is approved, assessed, started and initiated through business case documentation. Development of artefacts includes the project charter and also indicative and detailed business cases.<sup>93</sup> During the Acquisition phase, procurement contracts are concluded, the project implementation business case artefacts are developed, and then Cabinet approval is sought. Approval commits the Government to a contract along with future capital and operating expenditure and funding streams. The full or provisional acceptance of delivered capability, such as aircraft usually occurs at the end of this phase.<sup>94</sup> The Introduction-Into-service stage is the fourth phase, which progresses the finalisation of Acquisition Contract deliverables, and transitions the capability into

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<sup>89</sup> Vernon, "The Product Cycle Hypothesis in a New International Environment," 255.

<sup>90</sup> "Capability Management Framework," 11.

<sup>91</sup> "Better Business Cases - Introduction," The Treasury, <http://www.treasury.govt.nz/statesector/investmentmanagement/plan/bbc> (accessed 06 February, 2017).

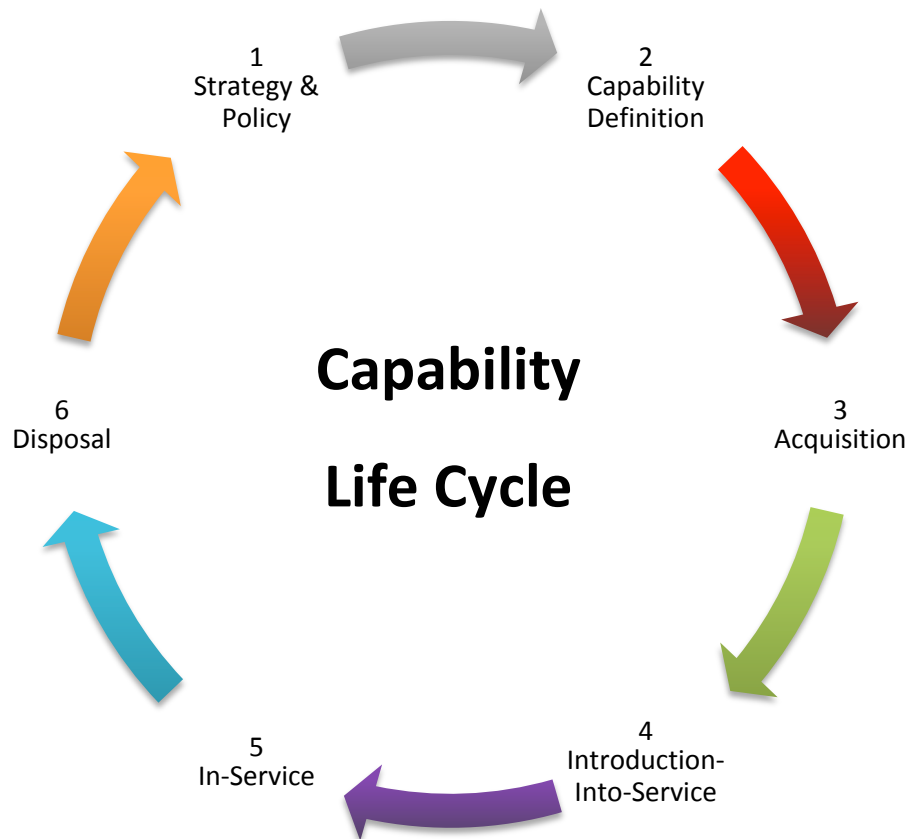
<sup>92</sup> Ibid.

<sup>93</sup> Ibid.

<sup>94</sup> Ibid.



operational service. In-Service is the fifth phase of the Capability Life Cycle and is generally the longest of all life cycle phases. The NZDF especially has a tendency for operating aircraft for forty years or more,<sup>95</sup> therefore this stage generates a majority of both capability benefit and capability whole of life costing. Disposal is the last of the six phases and is where military capability is withdrawn from service and disposed of in-line with the Capability Management Plan.<sup>96</sup>



**Figure 3 Capability Life Cycle (based on the Defence CMF)**

In 2016 New Zealand Defence agencies embarked on a Defence Capability Change Action Programme.<sup>97</sup> With an asset portfolio in excess of \$20 billion New Zealand dollars (NZD), and significant major capability projects still to come, the purpose of

<sup>95</sup> "Integrated Logistics Support in Capability Management Handbook," 5.

<sup>96</sup> "Better Business Cases - Introduction".

<sup>97</sup> "Introducing Defence: A Briefing for the Incoming Minister," (Wellington: Ministry of Defence; New Zealand Defence Force, 2017), 27.

the change programme was to lift Defence's capability procurement, management and performance. The objective of the programme was to improve the delivery of capability systems, from "good" to "great", while "still maintaining a smart, agile, and pragmatic approach to Defence procurement".<sup>98</sup> With a commitment to working across multiple Government agencies, Defence is focussed in its efforts to improve its track record, in particular within the areas of delivering affordable capability management systems and increasing Governments confidence in Defence's investment and overall capability management.<sup>99</sup> Defence needs to be committed to improving these areas because the gateway reviews that provide assurance to Treasury have highlighted that key programme and management issues applicable to all ministries including Defence, remain a problem in the areas of finance and procurement. For example, Treasury's 2017 Gateway Reviews Lessons Learned Report includes comment on transition into service, resourcing issues, benefit management and realisation, plus financial planning and management as key areas identified that need to improve in future major procurement projects. The report also highlighted concerns that 65% of lesson learned recommendations "around the application of core and programme management" outlined in the previous 2011 report, "lacked maturity".<sup>100</sup>

As part of the Defence Capability Change Action Programme, representatives of the MoD and NZDF launched the latest evolution of the CMF on 27 November 2017. Presenters including Secretary of Defence Helene Quilter of the MoD, and Vice Chief of Defence Force Air Vice Marshal Kevin Short jointly released to Defence personnel, the revised Capability Management System (CMS) incorporating the new Capability Management System Lifecycle (CMSL), which would replace the existing CMF and be implemented in mid-2018.<sup>101</sup> This was to complement the

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<sup>98</sup> "New Zealand Government Defence Capability Plan 2016," (Wellington: Ministry of Defence; New Zealand Defence Force, 2016), 7.

<sup>99</sup> Ibid.

<sup>100</sup> "Gateway Reviews - Lessons Learned," ed. The Treasury (Wellington: New Zealand Government, 2017), 11.

<sup>101</sup> Helene Quilter et al., "Launch of Capability Management System Conference Proceedings" (paper presented at the Defence Capability Change Program, Westpac Stadium, Wellington, 27 November 2017), pp 1 of handout provided to conference attendees.

already implemented Integrated Project Team (IPT) construct. IPTs comprising MoD and NZDF personnel, were stood up in February 2017 as major capability project teams taking an integrated approach to the accountability for and delivery of major complex capability systems at a project level. Quilter and Short announced the CMF had evolved through the review and adaption of international and domestic best practices, while also taking into account the uniqueness of the Defence environment. The purpose of the change to the capability framework was to meet current and future Defence capability management needs; the CMS will replace the existing framework for all major projects greater than NZ\$15 million.<sup>102</sup>

A number of key changes were highlighted during the launch. Most notably there is a change to the name of the framework along with an increased focus on whole of life costing models for major projects, and a continued focus on improving the working relationship between MoD and NZDF. The launch in November not only renamed the CMF to the CMS but also on closer inspection of the new system, there had also been a reduction in number of life cycle phases. As already highlighted in previous paragraphs, the current framework comprised of six phases and these were illustrated in Figure 3. The next iteration, the CMSL, combined the Acquisition and Introduction-Into-Service phases together and has named this stage the Capability Delivery phase. It is in this stage the IPT construct would be accountable for delivery of capability to Defence.<sup>103</sup>

Greater jointness between New Zealand Defence agencies is not a new concept, and neither is an increased focus on capability whole of life costing. Past reviews and reports such as the Strategos Report (1988), Hunn Report (2002), and the Defence Procurement Review (2009), have all emphasised the significance of this focus. The Strategos Report was commissioned by Government, which recommended significant changes to Defence. The report concluded sweeping State Sector Reform principles of the 1980s should be applied and adapted to

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<sup>102</sup> Ibid.

<sup>103</sup> Ibid.

reform New Zealand Defence agencies. There were five high level principles applied which were drawn from the State Sector Reform. These included recommendations that policy and advice should be segregated from governance and operations, that there should be clear delineation by role of responsibility along with maximum accountability. The report also suggested empowering managers to do their role, and that healthy competition to derive efficiency and minimise cost was encouraged.<sup>104</sup>

The terms of reference of the Strategos Report initially excluded matters of policy and operational and command responsibility. However, due to the unhelpful attitudes of personnel at the time from the Single Services, the information requested by reviewers was not forthcoming and therefore the terms of reference was changed by Government. In particular, the defiance by the Chief of Naval Staff, who virtually refused to comply with the review, compelled the Government to revise the scope to specifically include 'policy, operational and command responsibility'<sup>105</sup> In addition to recommending Defence reform, the review also focussed on a number of key assumptions, which ultimately became fundamental in moulding the CMF. In particular, this included a review of the changes in Defence policy outlined in the 1987 Defence White Paper. The Strategos report quickly found that the key objectives contained within the 1987 White Paper had not been linked to, nor had they been prioritised to drive the secondary supplemental objectives pinned to future capability requirements. This included important areas such as force structure, and capability and equipment<sup>106</sup> The Strategos report addressed the missing linkage and prioritisation, and proceeded to make recommendations regarding capability acquisition initiatives based the re-alignment and order of priorities.

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<sup>104</sup> Quigley, "The Evolution of Defence Policy," 44.

<sup>105</sup> Ibid.

<sup>106</sup> Ibid.

Outcomes from the Strategos Report would have a profound effect on New Zealand Defence agencies.<sup>107</sup> Recommendations contained within the Strategos Report included the creation of a Defence diarchy, whereby Defence should be governed by two independent authorities (MoD and NZDF).<sup>108</sup> The review also suggested the implementation of capability governance and reporting frameworks to allocate limited funding resources for the procurement and management of capability. The Strategos report suggested that rather than taking a single service approach, capability procurement justification and ensuing decisions to commit funds must align with the higher Government strategic military objectives across all of Defence. Government embraced these initiatives along with the need for transparency, clear accountability and separation of policy.<sup>109</sup> This also included a shift towards a 'Whole of Government' approach to security and capability, through the establishment of a capability framework that directly connects Defence outputs to Government policy, strategic priorities and public funding of capability acquisitions.<sup>110</sup>

The Hunn Report highlighted failings of earlier reviews. Changes to the Defence Act 1990 equated to a creation of two independent organisations and a separation of accountability between the 'civilian' based MoD, and the 'military' founded NZDF. Hunn advocated the need for another Defence revamp in part due to serious organisational attitudes and cultural differences that still existed. Such as increased transaction costs and growing tensions within each organisation, which led to a loss of trust, poor communication and cohesiveness. This result was the opposite of what was originally intended from the implementation of some of the Strategos Report recommendations. These changes were supposed to have fostered improved collaboration and jointness between New Zealand Defence agencies; instead the MoD and NZDF had grown wider apart and were still working

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<sup>107</sup> Michael Wintringham, "The Ministry of Defence and the New Zealand Defence Force Review of Structural Arrangements," (Wellington: Ministry of Defence, 2009), 7.

<sup>108</sup> "Defence Act 1990," 15.

<sup>109</sup> "The Ministry of Defence and the New Zealand Defence Force Review of Structural Arrangements," 7.

<sup>110</sup> Quigley, "The Evolution of Defence Policy," 41.

in isolation.<sup>111</sup> Changes to legislation and organisational responsibilities were recommended to force a change and develop a shared accountability between the Secretary of Defence and the Chief of Defence Force, and their respective organisations. The report noted that such changes would take time to approve and deploy, and suggested a practical multi-phased but nevertheless immediate approach to address the highlighted issues.<sup>112</sup> However, future reviews would highlight similar problems again.

Heads of the New Zealand Defence agencies as part of the wider Defence Review 2009, had commissioned the Defence Procurement Review. The review covered a raft of areas including the procurement and Through Life Support (TLS) decision-making process, whether there needed to be any changes to governance and management, and how capability requirements were developed and acquired. The review also identified which responsibility areas were carrying out capital procurement, and outline the 'optimal' establishment and skill sets to meet procurement requirements.<sup>113</sup> The review highlighted that not all recommendations from key previous reviews such as the Strategos and Hunn Reports had been implemented. In particular, the Hunn Report proposed changes to address systemic cultural and attitude issues such as the merging of the two organisations, but this had not been implemented and therefore those same fundamental problems were still in existence across Defence and within major capital procurement projects.<sup>114</sup> The Defence Procurement review also pointed out critical issues such as how the capability life cycle was being managed with concerns over Defence's difficulty in managing individual components of capability (known as PRICIE) over the whole capability life cycle rather than just within the Acquisition and Introduction-Into-Service stages. The NH90 project was cited as an

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<sup>111</sup> D.K. Hunn, "Review of Accountabilities and Structural Arrangements between the Ministry of Defence and the New Zealand Defence Force " (Wellington: Ministry of Defence, 2002), iii.

<sup>112</sup> Ibid., xii-xiii.

<sup>113</sup> "Review 09 - Procurement Process Review ", 1.

<sup>114</sup> Ibid., 17.

example of one of the major projects at the time struggling with addressing whole of life capability management concepts.<sup>115</sup>

The Defence Procurement Review (2009) found that past difficulties in implementing culture change across Defence was still evident. The Strategos Report had already previously stressed systemic issues and critical failings in the cultural approach to TLS. In particular, was the decisions taken as to what the acquisition projects would trade-off to satisfy fiscal constraints or political pressures.<sup>116</sup> The Procurement Review purported this culture had become the norm during the Acquisition and Introduction-Into-Service stages in an attempt to deliver projects on time and in budget. This then left the single Services to manage those trade-offs or deficiencies in deliverables, and absorb the resulting first, second and third order of effects in areas such as financial resources, organisational support, and personnel.<sup>117</sup> Changes that came about from the Strategos report were also not conducive to fostering the “symbiotic relationship” required between New Zealand Defence agencies to ensure a paradigm shift to an integrated whole of life approach in the procurement of major capability.<sup>118</sup> What is significant about the Defence Procurement Review was the observations became the impetus for the establishment of the IPT construct to manage future major capability acquisitions in an integrated way. However, nine years after the procurement review was carried out, the impact of historic acquisitions is still being felt today in units responsible for sustaining capability during the In-Service phase of the capability life cycle.

On multiple occasions, government commissioned reviews have highlighted a need for a whole-of-life approach across New Zealand Defence Agencies. Doctrine already stipulates the requirement to utilise the Defence ILS framework when

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<sup>115</sup> Ibid., 5.

<sup>116</sup> Greener, *Timing is Everything: The Politics and Processes of New Zealand Defence Acquisition Decision Making*: 123-24.

<sup>117</sup> "Review 09 - Procurement Process Review ", 5; Charles Haddon-Cave, "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," (London: British Government, 2009), 371, 405.

<sup>118</sup> "Review 09 - Procurement Process Review ", 5.

considering TLS. However to be effective in complying with and sustaining doctrinal intent, for this to occur it requires Defence to adequately invest in the philosophy, which is at odds with the findings detailed in Chapter 3 that suggests this is not translating into resources at an In-Service and a supply chain level.<sup>119</sup> NZDF Assistant Chief of Capability Air Commodore Andrew Clark, in his presentation during the CMS launch, stated “At the heart of the framework is the close partnership with MoD as the incumbent CMF had been completely rebuilt into a life cycle management system, a system which also includes the impending release of a newly aligned ILS framework”.<sup>120</sup> With a number of major air capability projects on the horizon,<sup>121</sup> the successful implementation of and adherence to the CMSL will be essential to the TLS and sustainment of those capabilities. There is a recurring theme within the Defence Capability Change Action Programme, which emphasizes a fundamental requirement for an integrated approach to capability management between New Zealand Defence agencies. This also included the desire to establish TLS sustainment arrangements at acquisition to maximise opportunities to leverage ‘value-for-money’<sup>122</sup> i.e. “spending less” through economy, “spending well” through efficiencies, and “spending wisely” through effectiveness, across the capability life cycle.<sup>123</sup>

Replacement of military air capability has followed a boom/bust cycle that stems from the WW2 era. History has shown that New Zealand has regularly suffered from antiquated and out-dated military capability, an issue that Peter Greener’s *“Timing is Everything”* describes as ‘block obsolescence’.<sup>124</sup> In the 1960s New Zealand purchased a number of new aircraft types in quick succession, which

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<sup>119</sup> D, Participant. "Supply Chain Study - Participant D." 1:30:56. Interview by Author. Sound Recording. RNZAF Base Wellington, May 11, 2017.

<sup>120</sup> Quilter et al., "Launch of Capability Management System Conference Proceedings."

<sup>121</sup> Peter Greener, "Reading Between the Lines - The Defence Capability Plan 2016," *Line of Defence: New Zealand's Defence And National Security Magazine* vol. 1, no. 3 Autumn (2017); Robert C. Owen, "Shaping New Zealand's Airlift Force for the Next 40 Years," *Line of Defence: New Zealand's Defence And National Security Magazine* vol. 1, no. 3 Autumn (2017).

<sup>122</sup> "Review 09: Procurement Process Review," (Wellington: Aurecon 2009), 12.

<sup>123</sup> "Assessing Value for Money," National Audit Office <https://www.nao.org.uk/successful-commissioning/general-principles/value-for-money/assessing-value-for-money/> (accessed 07 March, 2018).

<sup>124</sup> Greener, *Timing is Everything: The Politics and Processes of New Zealand Defence Acquisition Decision Making*: 151.



created a procurement cycle where aircraft would once again have to be replaced during a similar period as multiple aircraft types became obsolete in a short space of time.<sup>125</sup> The second and third order of effects occurring from mitigating block obsolescence has been the creation of short term Life Extension Programmes (LEP), such as the C130 Hercules and P3 Orion end of life and system upgrades to create the P-3K2 and C130 LEP.<sup>126</sup> Today there is significant risk that a perfect storm is forming as the New Zealand Government is now being forced to decide how to proceed with the next round of block aircraft obsolescence. At the time of writing, the government is grappling with key decisions on what aircraft capability will replace the mobility and surveillance capability currently carried out by the C130LEP, B757-200 and P-3K2 fixed wing aircraft. Moreover, this activity is likely to occur over a similar time period, creating an undesirable situation where multiple major air capability acquisition projects will once again clash, and placing pressure on an already resource-constrained NZDF.<sup>127</sup>

Unique to the acquisition of air power, New Zealand Defence agencies must also consider airworthiness in all of its acquisition decisions. Airworthiness and its impact on safety is the most critical area of sustaining aircraft. Airworthiness in military operations requires having “proficient persons in approved roles and environments operating aircraft to approved standards under a system of supervision and monitoring”.<sup>128</sup> Not unique to the RNZAF operations, airworthiness is a competency all aircraft operators globally must comply with, which has life and death consequences if not adequately met. Civil aviation authorities govern aircraft listed on the civil aviation registers, however most militaries including the NZDF, generally own their aircraft capability, and instead list the aircraft on the military register. Due to the nature of NZDF operations, risk and type of equipment used, military organisations work alongside civil aviation

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<sup>125</sup> Ibid.

<sup>126</sup> "Our Future Defence Force," in *Air Force News* (Wellington: Royal New Zealand Air Force, 2012), 7-9.

<sup>127</sup> Ibid.

<sup>128</sup> "Airworthiness in the RNZAF," *Air Force News* vol. July 2011, no. 127 (2011): 7.

authorities but are not required by law to comply with them, rather they are usually their own independent airworthiness authority.<sup>129</sup>

The RNZAF maintains and is its own airworthiness authority.<sup>130</sup> However, like European, Australia,<sup>131</sup> and UK air forces,<sup>132</sup> the RNZAF have a project under way to reform the NZDF airworthiness framework to meet internationally recognised European Military Aviation Regulations (EMARs)<sup>133</sup>. The intent is to 'harmonise' the airworthiness frameworks across military organisations.<sup>134</sup> At the International Military Airworthiness conference RNZAF Chief Engineer Group Captain Peter Griffin described the challenges of maintaining a bespoke airworthiness system in a small air force, and the intent for the NZDF was to adopt EMARS to reduce the burden and complexity of the existing framework, enhance safety, defensibility, authority independence, efficiency, interoperability, and mutual recognition.<sup>135</sup> EMARS is being championed by the European Defence Agency in line with the Military Airworthiness Authorities Forum (MAWA) establishment by European Defence ministers in 2008, and is represented by twenty seven EDA member states.<sup>136</sup> The adoption of EMARS by military airworthiness authorities will allow greater inter-operability with other militaries, opportunity for access to global spares pools and other shared or common sustainment and operating initiatives For example, in the future this will provide a

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<sup>129</sup> Leon Purton and Kyriakos Kourousis, "Military Airworthiness Management Frameworks: A Critical Review," in *3rd International Symposium on Aircraft Airworthiness, ISAA 2013* (Toulouse, France: Elsevier Ltd, 2013), 546.

<sup>130</sup> "Airworthiness in the RNZAF," 8-11.

<sup>131</sup> Tony Moclair, "Safety of Flight," *Australian Aviation*, no. January/February 2016 (2016): 42.

<sup>132</sup> Martin Clark, "Harmonising Airworthiness," *Aerospace*, no. February (2015): 36.

<sup>133</sup> Peter Griffin, "The EMAR Journey for the NZDF," in *International Military Airworthiness Regulation Conference* (Melbourne Convention and Exhibition Centre, Melbourne: The Defence Aviation Safety Authority, Department of Defence, 2016).

<sup>134</sup> Purton and Kourousis, "Military Airworthiness Management Frameworks: A Critical Review," 546.

<sup>135</sup> Griffin, "The EMAR Journey for the NZDF."

<sup>136</sup> "Military Airworthiness," ed. Publications Office (Brussels: European Defence Agency, 2013), 2-3.

greater opportunity for defence forces operating similar capability such as the NH90, to develop common initiatives and access to global spares pools.<sup>137</sup>

### **NH90 Helicopter Acquisition**

For forty years, RNZAF No. 3 Squadron operated the Iroquois helicopter fleet. Becoming operational in the 1960s, the Iroquois role was to provide support to Government outputs. However by the turn of the twenty-first century, they were coming to the end of their airworthiness and economic life, and no longer meeting existing and future Government capability requirements.<sup>138</sup> Whichever aircraft was to be chosen to replace the Iroquois fleet, it needed to be able to provide medium utility functions by carrying bigger payloads, over greater distances, and be able to operate in unfavourable weather conditions both day and night. In 2006, the MoD Long Term Development Plan estimated that replacing the Iroquois would cost in the order of \$400-550 million New Zealand dollars.<sup>139</sup>

The new NH Industries' medium utility Tactical Transport Helicopter NH90 (NH90) was selected as the replacement for the Iroquois. On 31 July 2006, the MoD signed a contract for eight NH90 helicopters, with a spares package that included an attrition airframe for parts, and training. At the conclusion of contract negotiations, the Government approved a commitment to acquire the helicopters at an escalated acquisition cost of \$771.7 million New Zealand dollars. This was a significant increase and exceeded the Government's original approved estimates by \$221.7 million New Zealand dollars. By the end of negotiations, it was apparent that the new helicopters could not be delivered until mid-2011, which was 42 months later than originally planned.<sup>140</sup>

The Medium Utility Helicopter (MUH) project team was headed by the MoD and was accountable for the delivery of the NH90 capability to Defence. This thesis focusses on three key stages involved in delivery of that capability to Defence

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<sup>137</sup> Purton and Kourousis, "Military Airworthiness Management Frameworks: A Critical Review," 546.

<sup>138</sup> "Reporting the Progress of Defence Acquisition Projects: Interim Report, June 2008," 37.

<sup>139</sup> Ibid.

<sup>140</sup> Ibid.

illustrated in **Error! Reference source not found.**, which includes the Acquisition, Introduction-Into-Service and In-Service phases. MoD worked to negotiate and deliver the capability Acquisition Contract during the Acquisition phase. The NZDF Capability Branch (CAPBR) worked closely with the MoD, and was responsible for the Introduction-Into-Service stage. Working intimately with the MoD and CAPBR, the RNZAF Directorate of Project Engineering and Certification (DPEC) was responsible for the activities that fulfilled introduction-into-service requirements. DPEC was also required to facilitate aircraft type certification, and the establishment of ILS arrangements to sustain the capability through life.<sup>141</sup> After these activities were completed, or often as the last bits and pieces of the introduction-into-service requirements were being met, the capability was transitioned to in-service where the RNZAF Fleet Support Teams (FST) took over the responsibility for capability sustainment.<sup>142</sup>



Figure 4 Major Air Capability Life Cycle Transition from Acquisition to In-Service (based on the Defence CMF & RNZAF FST construct)

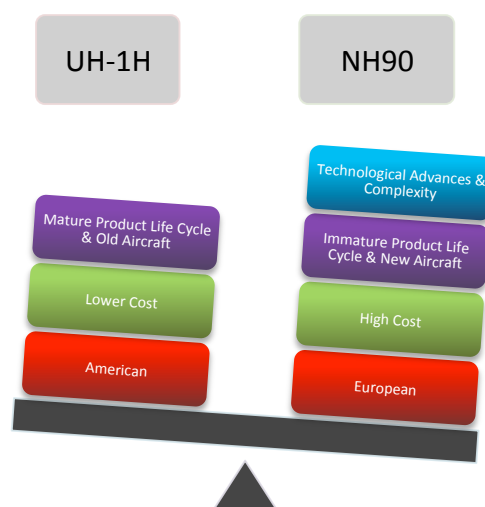
The Government selected the NH90 helicopter type to meet their current and future helicopter capability needs, however there would be fundamental distinctions between the Iroquois and NH90 that would change the way the NZDF sustained the new helicopter capability. Drawing from the primary and secondary research gathered as part of this thesis, high-level differences between the old Iroquois and new NH90 helicopters were identified, which have been illustrated in

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<sup>141</sup> "Major Projects Report 2013," 115; D, 2017.

<sup>142</sup> D, 2017.

Figure 5 below. These differentiations have had first, second and third order of effects, which has ultimately influenced the shape, and effort of introduction into operational service and sustainment activity. Firstly, the technological advances between the NH90 and the Iroquois were generations apart creating a monumental shift in complexity, corporate knowledge requirements, and cost.<sup>143</sup> Secondly the Iroquois was of American origin and primarily mechanical, whereas the NH90 was an acquisition of European design with advanced composite material, complex mechanics and an avionics ‘fly by wire’, requiring a heavy emphasis on sustainment and support complex componentry and software. The NH90 is a composite-based structure that was still immature in its design as the product entered into global service.<sup>144</sup> As global fleet hours increased so did the need to adjust designs, procedures and processes.<sup>145</sup> As time passed, the NZDF released capability and began operations within the RNZAF. It became apparent that as many other user nations had found, the New Zealand variant of the NH90 would also be expensive and challenging to sustain.<sup>146</sup>



**Figure 5 Key Difference Between UH-1H (Iroquois) vs NH90 Helicopter Fleet (based on Interviews & ANAO ‘Multi-Role Helicopter Programme’ Report<sup>147</sup>)**

<sup>143</sup> E, 2017.

<sup>144</sup> Ibid.

<sup>145</sup> F, 2017.; G, 2017.

<sup>146</sup> H, Participant. "Supply Chain Study - Participant H." 1.23.38. Interview by Author. Sound Recording. RNZAF Base Wellington, June 16, 2017.

<sup>147</sup> McNally, Linard, and Turnbull, "Multi-Role Helicopter Program," 13.

At the time New Zealand was purchasing the NH90 fleet, Australia was in the middle of their MRH90 procurement challenges. The Australian Government had faced many hurdles in the introduction, maintenance and sustainment of the MRH90 purchased for the Australian Defence Force (ADF).<sup>148</sup> As part of the Australian AIR 9000 Programme to replace the Army's S-70A-9 Black Hawk as well as the Navy's Sea King helicopters, in June 2005 Australia entered into a multi-stage contract with NHI for the delivery of 46 MRH90s.<sup>149</sup> As a way of achieving through life cost efficiencies, the Australians had focussed their strategy on decreasing the number of different helicopter types in operations within the Australian Army and RAN. The MRH90 project had surmised that by establishing a strategic one-stop-shop prime contract, Australia should expect to generate the required capability outlined in their Australian Defence Capability Plan, on time and in budget, by sharing risk, and increasing transparency with the prime contractor.<sup>150</sup> This focus became one of the compelling reasons Australia chose the MRH90 helicopter over its competitor, the S-70M Black Hawk.<sup>151</sup> However, like many of the 14 other NH90 user nations, it would not be an easy path for Australia to bring the fleet into operational service.<sup>152</sup> The Australian National Audit Office released a damning report in 2012 outlining the issues being experienced by the MRH90 programme.<sup>153</sup> In May 2013, the Australians negotiated a forty-seventh aircraft as part of a settlement package arising from contractual issues.

### **SH-2G(I) Super Seasprite Helicopter Acquisition**

New Zealand was well underway with the NH90 procurement project when the Government was offered a tantalizing proposition by Kaman Aerospace to purchase second-hand, upgraded Super Seasprite helicopters previously owned by Australia.<sup>154</sup> The RNZN No. 6 Squadron at the time was time operating the SH-

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<sup>148</sup> Ibid.

<sup>149</sup> Ibid., 16-17.

<sup>150</sup> Ibid., 13.

<sup>151</sup> Ibid., 15.

<sup>152</sup> "NH90 Programme and JMAAN Organisation," in *EDA Military Airworthiness Conference* (Aix en Provence: NH Industries, 2013), 5.

<sup>153</sup> "Multi-Role Helicopter Program," 13.

<sup>154</sup> D, 2017; "Naval Helicopter Replacement".;

2G(NZ) Seasprite variant maintained by the RNZAF, which was at the mature end of its product life cycle. At 15 years old, the “NZ” fleet had serious obsolescence issues and no longer met the capability required of a maritime helicopter. These aircraft had been pegged for replacement in 2015.<sup>155</sup> In 2008, Australia abandoned its efforts to introduce their SH-2G(A) Super Seasprite programme due to operational and safety concerns, contract issues and spiralling costs.<sup>156</sup> Known as the Super Seasprites, the SH-2G(A) fleet were originally acquired by Australia for use by the RAN to provide a range of maritime tasking.<sup>157</sup> During the project, an abundance of issues arose which resulted in Australia not being prepared to fully certify the fleet for military operations. Instead when the Type Certificate and Service Release was issued in December 2004, severe limitations on operations were attached. For example, key restrictions included the fleet not being able to land on vessels, there were centre of gravity constraints, all-up aircraft weights and payloads were limited, plus wind and lift off hover restrictions were put in place. Subsequently the Australians withdrew their airworthiness Military Type Certificate in May 2006, and the RAN did not operate the aircraft again.<sup>158</sup> The project spanned 12 years and cost approximately one and half billion Australian dollars before the Australian Government cancelled the project in 2008 and disposed of the fleet to Kaman Aerospace.<sup>159</sup>

In a decision that would have significant flow-on effects, the New Zealand Government decided to proceed with the acquisition of the pre-owned Super Seasprites. This was one of the first major capability acquisition projects to implement the CMF and Better Business Case methodologies at commencement.<sup>160</sup> With a project budget of \$252 million New Zealand dollars, the MoD entered into a contract with Kaman Aerospace in May 2013. The agreement was to purchase ten SH-2G(I) Super Seasprites (known as the ‘Seasprite’ in New Zealand), a spares

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<sup>155</sup> "Naval Helicopter Replacement".

<sup>156</sup> Little et al., "The Super Seasprite," 16-17.

<sup>157</sup> Ibid., 13.

<sup>158</sup> Ibid., 39.

<sup>159</sup> Ibid., 14.

<sup>160</sup> "Defence Capability and Resourcing Review (DCARR)," (Wellington: Ministry of Defence, 2005), 18.

package, and synthetic training devices, which included a full mission flight simulator.<sup>161</sup> The MHCP team was headed by the MoD who was accountable and responsible for the deliverables contained within the Acquisition Contract during the Acquisition stage. MoD, CAPBR, and DPEC again worked together to carryout introduction and transition into service activities. Aircraft type certification along with the establishment of ILS arrangements to sustain the capability over the life of the helicopters was the responsibility of DPEC.<sup>162</sup>

The New Zealand Government anticipated that the Seasprites would meet New Zealand's current and future capability requirements, and will remain in operational service until such time as the current RNZN frigates are replaced, which currently is slated to be 2030.<sup>163</sup> However, unlike in the case of the NH90 where there was little organic corporate knowledge at acquisition, the NZDF already carried a significant level of Seasprite experience through the operations of the previous 'NZ' variant.<sup>164</sup> Despite this expectation, there would be key high-level differences between the 'NZ' and 'I' variants illustrated in Figure 6 below, which would affect the sustainment of the capability. Firstly the technological differences in the avionics systems were significant. Unlike the 'NZ' model, avionics systems would be integrated and flow through the Integrated Tactical Avionics System (ITAS).<sup>165</sup> Secondly, unlike the NH90 these aircraft were at a very mature stage in their product life cycle. With a shrinking aftermarket to provide support, there was little impetus or business justification for OEMs or other suppliers to increase investment in support solutions for such a small number of aircraft operating globally.<sup>166</sup> As time would go on it became apparent that the Seasprite too would also be expensive and challenging for the NZDF to sustain.<sup>167</sup>

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<sup>161</sup> "Maritime Helicopter Replacement Project (MHCP)," Ministry of Defence, <https://www.defence.govt.nz/what-we-do/delivering-defence-capability/defence-capability-projects/maritime-helicopter-replacement-project-mhcp/> (accessed 18 February, 2018).

<sup>162</sup> "Major Projects Report 2016," (Wellington: Ministry of Defence, 2016), 115; D, 2017.

<sup>163</sup> "Naval Helicopter Replacement".

<sup>164</sup> C, 2017.; D, 2017.

<sup>165</sup> D, 2017.

<sup>166</sup> C, 2017.

<sup>167</sup> A, 2017.; C, 2017; D, 2017.



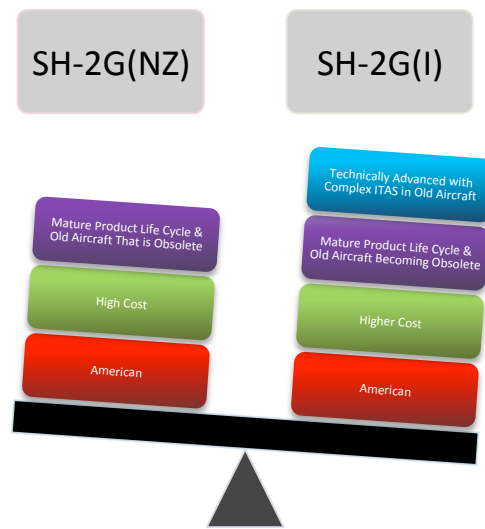


Figure 6 Key Differences Between SH-2G(NZ) vs SH-2G(I) Helicopter Fleet (based on interviews & ANAO 'Super Seasprite' Report<sup>168</sup>)

Prior to New Zealand's acquisition of the Seasprite, Australia experienced a number of significant issues that led to the cancellation of their Super Seasprite project. These arose during their attempt to acquire and introduce the fleet into operational service, and provide some insight into project complexity and risk. The Australian National Audit Office 'Super Seasprite' report highlighted a number of those failings before and during the project, crossing a breadth of major acquisition, capability and integrated logistics support issues.<sup>169</sup> Firstly, due to budget constraints financial calculations were based on 1994 pricing and allocated Government funding of \$746 million Australian dollars, which was insufficient to cover the capability requirements of the project. As a result, instead of increasing project funding, Australia reduced the scope of the project in order to stay within budget, which decreased the number of aircraft being purchased from 14 to 11. The project removed air-to-surface missile requirements and elected to refurbish existing airframes instead of buying new aircraft. Secondly, the requirements dictating the size of the helicopter became obsolete when the 'unapproved'

<sup>168</sup> "The Super Seasprite," 19.

<sup>169</sup> Ibid., 24.

Offshore Patrol Combatant (OPC) vessel project was cancelled a few months after the contract to procure 11 intermediate sized Super Seasprite designed to fit the OPCs, was signed.<sup>170</sup>

Thirdly, Australia also wanted to reduce the number of aircrew to operate the aircraft from three to two. This decision required design and development of the ITAS. Australia significantly underestimated the future challenges of proceeding down this path. The approach applied to reduce the aircrew configuration was complex and risky, especially when integrating critical flight safety and operational systems Aircraft mission systems such as avionics, navigation, weapons, communication and sensor required a significant upgrade to the critical Aircraft Flight Control Systems.<sup>171</sup> The number of crew was not an issue for the NZDF because they would continue to operate as per the previous variant, which was three aircrew and not two. Prior to the New Zealand acquisition, Kaman Aerospace had also rectified other technical issues highlighted in Australia's audit report into the Super Seasprite. Additionally, New Zealand employed an independent airworthiness expert, Marinvent Corporation, to inspect the aircraft to provide additional assurance to Government that Kaman Aerospace had satisfactorily addressed the identified airworthiness and safety concerns contained in Australia's audit report.<sup>172</sup>

Evidence was also beginning to emerge that Australia would be challenged in their ability to sustain the Super Seasprite helicopters. Because sustainment was not part of their Acquisition Contract, or negotiated concurrent to purchase of the aircraft, the Defence Material Office established the arrangements after the fact. The nexus of the support agreement did not adequately align with the Acquisition Contract, or Introduction-Into-Service activity. Neither did these arrangements effectively sustain the estimated operational tempo, spares requirements, or reliability, maintainability and maintainability data.<sup>173</sup> Additionally,

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<sup>170</sup> Ibid., 16-17.

<sup>171</sup> Ibid., 19.

<sup>172</sup> "Naval Helicopter Replacement".

<sup>173</sup> "The Super Seasprite," 19.

commencements of commercial support arrangements were not pinned to aircraft delivery and the spares package was not sufficient to support operations for three years in line with internal ADF expectations. The lack of spares occurred due to funding constraints. This failing left the ADF In-Service support and sustainment organisations to carry the shortfall in their budgets as they attempted rebuild spares holdings to the required level, all the while no aircraft had yet been formally accepted.<sup>174</sup>

The Australian National Audit Office (ANAO) Super Seasprite report also highlighted engineering and airworthiness concerns. Probes into the issues highlighted problems generated from a lack of general adherence to airworthiness engineering compliance, and an undesirable aircraft maintenance culture. Maintenance publications omitted the required airworthiness regulatory requirements to carry out independent maintenance inspections in critical maintenance operations. While in 2003 an intermediary process was implemented to mitigate airworthiness risk, in the following year there were at least five reported maintenance safety events and organisational ethos issues raised.<sup>175</sup> The review also inferred subjective general linkages to an undesirable naval maintenance and attitude culture,<sup>176</sup> which had also been pointed out in the inquiry into the Sea King crash on Nias Island during humanitarian aid operations for Sumatra.<sup>177</sup> An embedded systemic culture of short cutting maintenance process and undesirable human factors had impacted airworthiness and was specifically noted in the inquiry into the incident.<sup>178</sup> The occurrence of undesirable organisational culture is of concern to aviation operators such as the ADF and the NZDF as it poses potential future airworthiness risk in the operations and sustainment of military capability.

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<sup>174</sup> Ibid., 24.

<sup>175</sup> Ibid., 25-26.

<sup>176</sup> Ibid., 26.

<sup>177</sup> Ibid., 25-26.

<sup>178</sup> "Sea King Board of Inquiry," (Canberra: Department of Defence, 2006), Chapter 8, 2-3.

This chapter has examined a number of fundamental concepts that flow throughout the thesis. Vernon's Product Life Cycle theory provides the academic link to the Defence Capability Life Cycle whereby following a similar pattern when considering the transition of a product or aircraft capability from Introduction to Decline. The development of the Capability Management Framework, which dictates how Defence procures and manages capability across the Capability Life Cycle, has been shaped through historic Defence reviews, which have also driven the current governance and management structure of New Zealand Defence agencies. Greener's pioneering insight into the history behind the large scale cyclical Defence acquisitions to address block obsolescence holds true today as it provides context as to why once again the New Zealand Government is about to enter a period where future multiple aircraft types will be procured to address the simultaneous replacement of aging RNZAF aircraft such as the C130 LEP, B757-200, and P-3K2. Defence have recently procured the NH90 and Seasprite helicopters two case studies, which introduces the intricacies of acquiring aircraft. The introduction of complex considerations, such as cost, product maturity and airworthiness, plus the challenges experienced by New Zealand and other nations bringing the aircraft into operational service, along with the management of the subsequent through life support and sustainment, are all areas discussed in greater detail in later chapters of the thesis.

## Chapter 2 – Sustainment of Defence Capability

“For good or for ill, air mastery is today the supreme expression of military power and fleets and armies, however vital and important, must accept a subordinate rank”.

Winston Churchill, 1949<sup>179</sup>

Military logistics is the discipline of positioning, supporting defence forces in military operations to enable and sustain military preparedness and effect.<sup>180</sup> Logistics must be carefully considered before, throughout, and at the conclusion of military operations. Alexander the Great and King of Macedonia, is an excellent example of a General that was feared for his ferocious war-fighting tactics, but also admired for his legendary logistic prowess and principles of raising, training, and sustaining the Macedonian armies. Caesar, Napoleon and Rommel have all studied the sustainment strategies and tactics of Alexander the Great<sup>181</sup> Logistics was a fundamental part of his strategic campaign planning, and he made sure that he knew as much as he could about his enemies, their resources and food sources. His armies implemented technological advances of the time, and were fitted out with modern weaponry, as he made sure that there was only one single point of control over logistic and sustainment activity. These success factors have become founding principles of contemporary supply chain management and in the sustainment of military capability.<sup>182</sup>

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<sup>179</sup> William Woodruff, *The Struggle For World Power: 1500 - 1980* (London: The MacMillan Press Ltd, 1981). 315.

<sup>180</sup> "Defence Logistics: NZDDP - 4.0," (Wellington: New Zealand Defence Force, 2013), iii.

<sup>181</sup> Timothy Van Mieghem, "Logistics lessons from Alexander the Great," *Quality Progress* vol. 31(1998): 41.

<sup>182</sup> Ibid.

In the twenty first century, globalisation along with information and technology advances has had a significant impact on the shape of warfare, including logistics. Aeronautical platforms and major weapon system, plus associated equipment have leapt forward with major improvements in capability through technological advances in avionics, software and mechanical systems. Military organisations including the NZDF, envisaged that innovation would reduce the need for mass forces and theoretically the volume of logistic support needed.<sup>183</sup> However, contemporary product offerings from aeronautical manufacturers and the wider defence industry have also increased the complexity of military capability, products and services. This has, in turn created a greater reliance on and need for global commercial entities to provide ILS solutions to sustain military capability.<sup>184</sup>

Advances in technology have also enabled the evolution of sustainment and logistic support of military capability in warfare. Over the last century, technological advances in complex weapons system, manufacturing knowledge and process, improvements in transportation, and especially the introduction of air power, have all had a significant effect.<sup>185</sup> Air power is the ability to project power from the air and space to influence the behaviour of people, or the course of events.<sup>186</sup> Air power has speed, height and reach, characteristics that have rapidly changed over the last century. The evolution of air power capability and its implementation within military air operations has added a whole other dimension with vast improvements in speed, mobility and reach, thereby re-shaping methods of logistics support delivery. During the 1991 Gulf War, the rapid deployment of US Forces meant that the logistic tail had to sustain a swift tempo to match military operations using air and sealift. US Army Lieutenant General William G. Pagonis, Director of Logistics during the Gulf War, highlighted that air power facilitated the

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<sup>183</sup> "New Zealand Defence Doctrine NZDDP-D," ed. Capability Branch The Doctrine Cell (Wellington: New Zealand Defence Force, 2012), 65.

<sup>184</sup> Ward, "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," 16.

<sup>185</sup> "Defence Logistics: NZDDP - 4.0," 4-6.

<sup>186</sup> "Role of Air Power," Royal Air Force, <https://www.raf.mod.uk/role/role-air-power.cfm> (accessed 22 December, 2017).

speed of which the US military deployed into theatre of operations. Strategic airlift was significantly quicker than in previous campaigns.<sup>187</sup>

From a manufacturing standpoint, the industrial revolution in industry that occurred in the twentieth century and aided advances in air power, created a paradigm shift. Prior to this, industry was a manpower-intensive production model, however the paradigm shifted as technology innovation and advances allowed more efficient and streamlined automated production process. This resulted in reduced levels of manpower required, and sped up production. In turn the reduction of personnel required freed up men to serve their country in the war efforts.<sup>188</sup> In the modern era technological advances in air capability in particular have allowed manufacturers to focus their efforts to bring product to the market quicker and to reduce acquisition delivery time through concepts such as incremental capability releases, and spiral upgrades.<sup>189</sup> Conversely however this has also added a significant level of complexity to the manufacturing of aircraft capability, and therefore the need for more contemporary maintenance and sustainment solutions.<sup>190</sup> Despite advances in technological complexity, the RNZAF typically operates and sustains military products for a capability lifecycle of forty years or more.<sup>191</sup> As a comparatively small defence force, the capability life cycles tend to include mid-life product upgrade stages to address obsolescence issues and extend the life of the capability. Thus while choosing to update existing air capability rather than purchasing new, it adds complexity to sustainment through technological upgrades. In recent years, the NZDF has demonstrated this with the P-3K2 aircraft upgrades with a range of military and commercial off the shelf options to extend their operational life in the RNZAF.<sup>192</sup> However this approach has contributed to undesirable first, second and third order of effects from the

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<sup>187</sup> William G. Pagonis, *Moving Mountains: Lessons in Leadership and Logistics from the Gulf War* (Boston, Massachusetts: Harvard Business School Press, 1992). 86-87.

<sup>188</sup> "Defence Logistics: NZDDP - 4.0," 3-5.

<sup>189</sup> Mike E. Farmer, Guy J. Fritchman, and Kenneth J. Farkas, "Supporting the Fleet in the 21st Century: Evolutionary Acquisition and Logistics," *Air Force Journal of Logistics* vol. 27, no. 1 (2003): 27-28.

<sup>190</sup> Ibid.

<sup>191</sup> "Integrated Logistics Support in Capability Management Handbook," 5.

<sup>192</sup> Quigley, "The Evolution of Defence Policy," 58.

rapid onset of obsolescence arising from technical upgrades of components being fitted to the aircraft as part of, and during the higher level aircraft upgrade which created sustainment issues for the supply chain.<sup>193</sup> In particular obsolescence issues have become critical to maintaining serviceable and available aircraft creating challenges such as procuring spares and other material to carry out repair and maintenance activity on aircraft systems.<sup>194</sup> Where these items had been superseded or withdrawn from the market altogether, the supply chain found it difficult to source to meet sustainment requirements as the NZDF continues to push out the lifespan beyond market support of many of the components and aircraft systems.<sup>195</sup> This in turn has highlighted the need for agile, flexible and cost effective logistic support footprints to sustain operations over the capability lifecycle, a view that is also held by Government and New Zealand Defence agencies alike.<sup>196</sup>

### **Integrated Logistic Support**

A fundamental doctrinal component of TLS is integrated logistic support.<sup>197</sup> Contained within Defence Force doctrine, ILS is a key element to sustaining capability. ILS is defined by the NZDF as the “the ability to achieve a desired operational objective in a selected environment, and to sustain that level of effort for a designated period”.<sup>198</sup> Military capability is an ensemble of people, research and development, infrastructure and organisation, concepts, doctrine and collective training, information technology, equipment, logistics and resources (PRICIE).<sup>199</sup> Introduced in 2006 with the establishment of the NZDF ILS Centre of Expertise, Defence refined the ILS model to meet its own needs.<sup>200</sup> The NZDF

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<sup>193</sup> "Major Projects Report 2013," 132; A, 2017.

<sup>194</sup> Martin Van Creveld, *Supplying War: Logistics from Wallenstein to Patton*, Second Edition ed. (Cambridge: Cambridge University Press, 2004). 254.

<sup>195</sup> Ibid; A, 2017; B, 2017; C, 2017.

<sup>196</sup> Quilter et al., "Launch of Capability Management System Conference Proceedings."

<sup>197</sup> "ILS Framework Overview for Projects/Programmes Greater Than \$15m," 5.

<sup>198</sup> "New Zealand Defence Doctrine NZDDP-D," 71.

<sup>199</sup> "Integrated Logistics Support in Capability Management Handbook," 5.

<sup>200</sup> H, 2017.



intent was to strive for “capability preparedness; reduced life cycle costs; optimised TLS; and continuous improvement”.<sup>201</sup>

ILS was first developed in the 1960s by the US military to standardise the procurement of military capability. The ILS methodology was designed to combat supportability and cost issues arising from the impact on the maintenance and sustainment of equipment from increasing complexity and technological advances of products.<sup>202</sup> The user of the military capability has certain expectations about how capability will be supported by logistics. Clearly identifying the need including functional support requirements is fundamental.<sup>203</sup> For logistics to be successful, it is fundamental that a predetermined and clearly defined capability system requirement is established in advance of procuring capability. This allows logistics to shape support systems to sustain capability requirements within acceptable maximum and minimum tolerances, and cost. To meet acceptable outcomes based on capability requirements, the logistic activities should be systematic and be able to be measured.<sup>204</sup> Key performance indicators to measure logistic success may be assessed on tangible criteria,<sup>205</sup> such as availability, lead-time, form fit or function, and price. Intangible characteristics might include more subjective measures such as look, feel and perceived ‘value-for-money’.<sup>206</sup>

ILS is globally recognised as a best practice methodology. The NZDF ILS Centre of Expertise has developed and published a number of policy and guidance resources in hard copy and online.<sup>207</sup> These are available to all personnel including those wanting ‘self-help’ to gain more knowledge about sustainment mechanisms inside

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<sup>201</sup> "Integrated Logistics Support in Capability Management Handbook," 1.

<sup>202</sup> George T. Babbitt, "An Historical Review of the Integrated Logistic Support Charter" (Defence Systems Management School, 1976), 4.

<sup>203</sup> Jones, *Integrated Logistic Support Handbook*: 2.1.

<sup>204</sup> "Performance Measurement: Advice and Examples on How to Develop Effective Frameworks," (Wellington: State Services Commission, 2008), 2; Tony Wills, "Vendor Performance Management NH90 and A109 Supply Chain" (Report, Otago Polytechnic - Capable NZ, 2016), 2.

<sup>205</sup> "Standards New Zealand," Ministry of Business, Innovation and Employment, <http://www.standards.govt.nz/?gclid=CNvB5tm8zM8CFYOavAodJYILrg> (accessed 08 October, 2016). "Vendor Performance Management NH90 and A109 Supply Chain," 2.

<sup>206</sup> Jones, *Integrated Logistic Support Handbook*: 1.1-1.5. Bolstorff and Rosenbaum, *Supply Chain Excellence a Handbook for Dramatic Improvement Using the SCOR Model*: 58.

<sup>207</sup> "Integrated Logistics Support in Capability Management Handbook," 25.

the CMF. There is also a wide variety of external resources available including the detailed handbook from internationally recognised academic and expert on ILS and supportability engineering, James Jones.<sup>208</sup> Standards New Zealand ISO 15288 for System Life Cycles,<sup>209</sup> the Supply Chain Operational Reference Model (SCOR),<sup>210</sup> and the Performance Measurement Process (PuMP) framework,<sup>211</sup> also provide very useful guidance for organisations. Many foreign armed forces including those of the USA, UK and Australia have fully embraced ILS policy and guidance into their capability acquisition and sustainment programmes.<sup>212</sup> Capability ILS concepts have a direct flow on affect for the supply chain responsible for carrying out the sustainment. Organisations such as the Chartered Institute of Procurement and Supply,<sup>213</sup> the American Production Inventory Control Society (APICS), which encompasses the Supply Chain Council<sup>214</sup> and includes the best practice supply chain philosophy SCOR,<sup>215</sup> all provide models and resources that augment aircraft capability sustainment.

James Jones asserts that the core logistic requirement to support capability in operations has not changed overtime. Instead Jones suggests that what has changed is the complexity and technical advances of those capabilities.<sup>216</sup> Capability systems requiring support have hierarchal levels of integrated elements; systems may also be a sub-level element itself of higher capability.<sup>217</sup> The fit and desired outcomes of ILS to enable capability, is determined by holistic

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<sup>208</sup> Jones, *Integrated Logistic Support Handbook*: 1.3.

<sup>209</sup> "AS/NZS ISO/IEC/IEEE 15288:2015 System and software engineering - System life cycle processes," (Wellington: Ministry of Business Innovation and Employment: New Zealand Standards, 2015), 1.

<sup>210</sup> Bolstorff and Rosenbaum, *Supply Chain Excellence a Handbook for Dramatic Improvement Using the SCOR Model*: 9-16.

<sup>211</sup> B, 2017; F, 2017.

<sup>212</sup> "Defence Standard 00-600: Integrated Logistics Support Requirements for MOD Projects," (Wellington: Ministry of Defence, 2016).

<sup>213</sup> "CIPS," Chartered Institute of Procurement and Supply, <https://www.cips.org/en-NZ/> (accessed 08 October, 2016).

<sup>214</sup> "APICS Home," APICS Supply Chain Council, <http://www.apics.org/sites/apics-supply-chain-council> (accessed 08 October, 2016).

<sup>215</sup> *Supply Chain Excellence a Handbook for Dramatic Improvement Using the SCOR Model*: 9-16.

<sup>216</sup> Jones, *Integrated Logistic Support Handbook*: 1.3.

<sup>217</sup> "AS/NZS ISO/IEC/IEEE 15288:2015 System and software engineering - System life cycle processes," 11.

organisational objectives.<sup>218</sup> Over the life cycle, fundamental products and services are needed to enable the capability to produce outputs. The relationship between the capability and enablers may be simple, complex, and multi-directional across and up and down the internal and external organisations. Capability and support enablers must be considered together during each stage of the life cycle.<sup>219</sup> ILS remains a doctrinal foundation and the core component in a “whole-of-life” systems based methodology to TLS in the sustainment of military capability.<sup>220</sup>

The degree to which ILS is successfully implemented within major military acquisitions can vary. The ability to sustain military capability over the life cycle is largely dependent on a number of factors. This includes the availability of clearly defined user requirements and early inclusion of ILS expertise to develop support and sustainment concepts factored into procurement decisions. Furthermore, the ability to leverage the value of capital acquisition through concurrent negotiation of through life sustainment arrangements provides a greater opportunity to reduce whole of life cost, and establish effective through life ILS.<sup>221</sup> Early engagement with and attention to ILS considerations in the Capability Life Cycle can provide significant value to a project. Benefits include “influence the design of the system; identify and develop support requirements that are related to and supportive of readiness objectives; acquire necessary support at minimum cost”.<sup>222</sup> International standards such as ISO 15288 and Military Standard 1388 1a and 2b also provide a globally recognised systems approach to system life cycles and ILS. These standards provide a systems-based theoretical framework and guide for organisations that aid in the “definition, control and improvement of system life cycle process”. They are applied at all stages of the life cycle and across projects,

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<sup>218</sup> *Integrated Logistic Support Handbook*: 1.1-1.5.

<sup>219</sup> “AS/NZS ISO/IEC/IEEE 15288:2015 System and software engineering - System life cycle processes,” 12-13.

<sup>220</sup> “Integrated Logistics Support in Capability Management Handbook,” 8.

<sup>221</sup> Farmer, Fritchman, and Farkas, “Supporting the Fleet in the 21st Century: Evolutionary Acquisition and Logistics,” 28.

<sup>222</sup> Jones, *Integrated Logistic Support Handbook*: 1.6.

acquisition, support activities, business networks, relationships, and stakeholder engagement.<sup>223</sup>

Sustainment and logistic cost is the biggest expense to supporting and enabling military capability over the systems useful life. It is fundamental to defence forces that the never-ending need for ILS is planned for in the most effective and economical way.<sup>224</sup> Seven high level support elements are contained within the initial ILS model developed by the US military, including: Maintenance capability; Supply Support; Personnel; Facilities; Support Equipment; Test Equipment; and Technical Data.<sup>225</sup> The NZDF on the other hand, has adapted this theory to suit and has broken their model into ten elements that must be considered to sustain Defence capability. These comprise Engineering Support; Maintenance Support; Supply Support; Packaging, Handling, Storage and Transportation; Training and Training Support; Facilities; Support and Test Equipment; Personnel; Technical Data Management; and Computer Support.<sup>226</sup> Additionally, where a major NZDF capability is concerned, such as an entire aircraft capability, the NZDF has found a simple checklist of just the ten ILS elements is not sufficient. Instead, the NZDF has developed pertinent Support System Constituent Capabilities (SSCCs).<sup>227</sup> For major military acquisitions over the value of seven million New Zealand dollars, the ten elements are essentially considered across each of the five SSCCs including Operating, Engineering, Maintenance, Supply and Training.<sup>228</sup> Additional components that augment ILS, such Logistic Support Analysis, Level of Repair Analysis etc.,<sup>229</sup> is not included in the scope of this thesis.<sup>230</sup>

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<sup>223</sup> "AS/NZS ISO/IEC/IEEE 15288:2015 System and software engineering - System life cycle processes," 1.

<sup>224</sup> *Integrated Logistic Support Handbook*: 1.6 - 1.9.

<sup>225</sup> *Ibid.*, 2.7.

<sup>226</sup> "Integrated Logistics Support in Capability Management Handbook," 6.

<sup>227</sup> Asset value greater than NZD\$7m

<sup>228</sup> "Defence Force Order (DFO) 52 - Procurement," in *Integrated Logistic Support* (Wellington: New Zealand Defence Force, 2013), 19-4.

<sup>229</sup> "Integrated Logistics Support in Capability Management Handbook," 8.

<sup>230</sup> Kumar and Krob, *Managing Product Life Cycle in a Supply Chain*: 12-13.

Enabling Systems across the stages of the life cycle form a critical part of producing and sustaining operational military capability.<sup>231</sup> These can be described as either the simplified ten elements of ILS, or across the more complex SSCCs.<sup>232</sup> From a systems perspective, the Agreement Process within system life cycle processes is the primary area which affects and influences the sustainment of capability, and thus impacts the supply chain.<sup>233</sup> This process establishes agreements between internal and external stakeholders, which outlines the products and services being acquired by one entity, and the how those requirements will be supplied and supported by the other entity. A successful outcome is determined by the effectiveness of the user requirement at inception, the selection of the right supplier(s), and an agreement between the two entities is executed. After which the delivery of the product and services occurs and is accepted, with obligations contained within the agreement being satisfied by both parties.<sup>234</sup> Acquiring the required level of support is essential to sustaining capability, which in turn enables the capability to achieve operational readiness.<sup>235</sup>

### **Paradigm Shift in Aeronautical Sustainment and Maintenance**

Product life cycles within aeronautical manufacturing, maintenance and sustainment organisations have taken on dynamic attributes. As new military capability products are introduced to the market, and technological advances and efficiencies are realised, this has stimulated consumer changes in demands and requirements along with it. Evolution within the aeronautical industry occurs as product offerings mature, and 'customers' supply chains develop a depth of corporate knowledge on the behaviour of capability and how best to support that capability over the life cycle.<sup>236</sup> Historically Original Equipment Manufacturers (OEMs) of aircraft have focused on the development and production stages of the

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<sup>231</sup> "AS/NZS ISO/IEC/IEEE 15288:2015 System and software engineering - System life cycle processes," 12.

<sup>232</sup> "Integrated Logistics Support in Capability Management Handbook," 16.

<sup>233</sup> "AS/NZS ISO/IEC/IEEE 15288:2015 System and software engineering - System life cycle processes," 19.

<sup>234</sup> Ibid.

<sup>235</sup> Ibid., 82.

<sup>236</sup> Lee and Edwards, *Marketing Strategy: A Life-Cycle Approach*: 165.

Product Life Cycle. Then 'after' market entities would step in to provide TLS options for customers, or customers themselves have developed in-house capability to provide TLS for their aircraft capability.<sup>237</sup> Over time this historic approach has evolved.

Ward's and Graves's studies carried out provided insight into three key areas driving the evolution of sustainment in the Aerospace industry. Firstly, despite the frequent use of terminology such as 'through life support' or 'through life support management', there was no one definition that was accepted by key stakeholders like OEMs, maintenance providers, civilian and military customers, to benchmark the definition of TLS against. Secondly, in 2003 the Aerospace Innovation and Growth Team advocated the need for the aerospace industry to increase market share.<sup>238</sup> Opportunities to generate value had increased as customer demand was diversifying. Thirdly, no longer did either civilian or military customers want OEMs to just to provide the production of capability during the Acquisition phase,<sup>239</sup> instead there was an increased appetite for manufacturers to provide a whole suite of integrated products and services that would support the capability from the beginning to the end of the Product Life Cycle.<sup>240</sup> Equally however with advances in technology, the level of OEM investment required in research and development, intellectual property complexity, and constraints on customer budgets, OEMs increased their product offerings to include one-stop-shop sales and after-market support options for customers.<sup>241</sup> This too created competitive advantage opportunities, and the ability to protect future revenue streams for the aerospace industry, while reducing the cost of ownership to the customer.<sup>242</sup>

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<sup>237</sup> Randy Starr et al., "Creating Value Through Integrated Products and Services in Aerospace and Defense," *Strategy&* (2009): 7, 10.

<sup>238</sup> Ward, "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," 2.

<sup>239</sup> Ward and Graves, "Through-Life Management: The Provision of Integrated Customer Solutions By Aerospace Manufacturers," 6.

<sup>240</sup> Starr et al., "Creating Value Through Integrated Products and Services in Aerospace and Defense," 6-8.

<sup>241</sup> Lee and Edwards, *Marketing Strategy: A Life-Cycle Approach*: 165.

<sup>242</sup> Ward, "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," 6-7.

However, suppliers needed to tread carefully when realigning organisational strategy, investment cases and processes to meet changing demand. To effectively provide the ILS that customers require over the life of the product or capability, OEMs need to ensure that organisational strategy, product maturity, resources, maintenance philosophy, culture and supply chains are developed and maintained in such a way that they remain profitable. All the while the OEM's changes in strategy still need to meet customer deliverables, 'value-for-money' and capital investment expectations, as well as aircraft serviceability, maintainability and availability requirements.<sup>243</sup> Entities striving for an evolutionary change in their product offerings had to make sure they knew where in the product life cycle they could grow value, and the type of integrated product and services needed to meet customer demand. Organisations needed to invest in capabilities that delivered the products and services to create that value, and review their current operating model and strategic focus to ensure it aligned with a change in product offerings<sup>244</sup> As a customer, it is important that a supplier integrates and aligns internal product life cycle activity so that the Supplier can deliver on what is promised.<sup>245</sup>

Conversely while there is a push for integrated support options by customers throughout the life of either the military or civilian capability, this may become a double-edged sword. Integrity of supplier transparency around cost of ownership is one area of concern, and the other is the loss of control over the capability if transferring historically customer-owned activity to sustain the capability, into the hands of the supplier. While the transfer of responsibility, control, risks and reward is formalised through contractual mechanisms in theory, fear arises in who actually has ownership of the risk in operations should an incident occur.<sup>246</sup> Additionally past experiences with OEMS have encouraged a culture of risk aversion in customers. This leads to uneasiness when there is a loss of control over

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<sup>243</sup> Ibid.

<sup>244</sup> Starr et al., "Creating Value Through Integrated Products and Services in Aerospace and Defense," 9.

<sup>245</sup> Ward, "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," 6-7.

<sup>246</sup> Ibid.

their capability and a situation occurs. Often this arises when the customers' organisations cannot react to a situation in such a way as they have done previously when the responsibility for support rested solely with them. Effective relationships between suppliers and customers become imperative to successfully realise the benefits for all parties from the through life integrated support solutions.<sup>247</sup>

Intellectual Property is another area where suppliers have shifted their strategic focus. The Oxford dictionary defines intellectual property as "Intangible property that is the result of creativity, such as patents, copyrights, etc."<sup>248</sup> From a supplier perspective, intellectual property is now fiercely protected due to its monetary value and competitive advantage. For the customer, this forces their organisations down a path of having to procure directly from the OEM. This is needed to protect any applicable valuable warranties with the supplier, and gain access to the required material, products or services which may be more costly than trying to reduce whole of life cost through third party after market entities. OEMs now offer a customer service infused approach to the more traditional engineering services, technical publications, as well maintenance repair and overhaul, plus spares procurement.<sup>249</sup> However if the supplier cannot prioritise these commitments due to misaligned organisational focus and strategies, this likely will place strain on customer relationships. Customer frustration increases through a lack of their ability to sustain capability due to the supplier not being able to deliver on time where the OEM is internally competing with itself to meet new sales production priorities as well as customer in-service support commitments.<sup>250</sup>

NHI is an example of an OEM demonstrating these challenging behaviours. Initially four individual OEMs came together in an inter-organisational relationship,<sup>251</sup>

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<sup>247</sup> Ibid.

<sup>248</sup> "Oxford Living Dictionaries," Oxford University Press, <https://en.oxforddictionaries.com/> (accessed 21 January, 2018).

<sup>249</sup> "Through-life Management: A Catalyst for Process Excellence in Customer Support and Maintenance, Repair & Overhaul (MRO)," 11-13.

<sup>250</sup> Ibid., 7-8, 31.

<sup>251</sup> Ibid., 33.



which spanned three countries. Eurocopter (now Airbus) France and Germany, AgustaWestland (now Leonardo) in Italy, and Fokker in the Netherlands, joined together to form NHI along with a mandate to produce and sell NATO helicopters to NATO countries, and which would be managed through the NATO Helicopter Management Agency (NAHEMA). As time went on production delays continued to increase, while those customers that had earlier deliveries of the NH90s now needed in-service support to meet their needs. Exasperatingly, NHI was still focused on production and not well set up to meet in-service requirements leading to priority conflicts and NHI not being able to react to in-service demands in a timely way. This caused many delays in delivery of spares, customer frustration, grounded aircraft and a growing problem for NHI.<sup>252</sup>

The paradigm shift from a traditional OEM capability production focus to providing integrated TLS solutions is here to stay. Civilian customers and military institutions expect to secure TLS options at the time of capability acquisition. The NZDF is no exception.<sup>253</sup> As previously stated, one of the factors in the Australian selection of the MRH90 over the Black Hawk helicopter, was the ability to contract the provision of TLS for the fleet through the OEM's subsidiary, Australian Aerospace (now Airbus Australia).<sup>254</sup> While there is a need to embrace mutually beneficial, efficient and 'value-for-money' TLS solutions to sustain military capability, caution must remain as organisations strategise future TLS options by considering stakeholder risk, responsibility, and accountability for operations and whole of life costing across the value chain.<sup>255</sup> Paradigm changes provide and opportunity for New Zealand Defence agencies to negotiate TLS arrangements at the time of acquisition. This allows the NZDF where possible to leverage support and cost through whole of life investment in the capability. This is an approach that

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<sup>252</sup> ; "Germany Not Happy with NH90 Helicopter," United Press International, <https://www.upi.com/Germany-not-happy-with-NH90-helicopter/28161267127259/> (accessed 10 March, 2018); Suila, "Finland's Helicopter Program; McNally, Linard, and Turnbull, "Multi-Role Helicopter Program.";

<sup>253</sup> Quilter et al., "Launch of Capability Management System Conference Proceedings."

<sup>254</sup> McNally, Linard, and Turnbull, "Multi-Role Helicopter Program," 13.

<sup>255</sup> Haddon-Cave, "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," 11-14, 427, 82.

is already in use with the recent upgrade of the Underwater Intelligence, Surveillance and Reconnaissance capability.<sup>256</sup> Negotiations of both the acquisition and TLS commercial arrangements were carried concurrently and executed simultaneously.<sup>257</sup>

### **The Royal New Zealand Air Force Supply Chain**

The supply chain plays an important role in the support and sustainment of defence capability. There are a multitude of definitions for the term Supply Chain, however the Chartered Institute of Procurement and Supply (CIPS) advocates that a supply chain is “the entire physical process from obtaining the raw materials through all process steps until the finished product reaches the end consumer”.<sup>258</sup> The supply chain is typically made up of sections of a value chain that are connected by the necessity to satisfy the needs of the customer; links in the chain can consist of multiple organisations, or be derived from separate functional areas within the same organisation.<sup>259</sup> Procurement on the other hand, can be defined as “the business management function that ensures identification, sourcing, access and management of the external resources that an organisation needs or may need to fulfil its strategic objectives”.<sup>260</sup> The RNZAF supply chain embraces similar concepts to both Supply Chain and Procurement in the sustainment of air capability. RNZAF supply chain resources are one half of the FST construct; the other being the technical support function for each capability.<sup>261</sup> The supply chain fulfils a number of primary sustainment and support functions. Core outputs of aeronautical supply chain within the RNZAF Material Support Wings are

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<sup>256</sup> Franz-Stefan Gady, "New Zealand to Upgrade Anti-Submarine Warfare Capability," *Asia Defense*(2016), <https://thediplomat.com/2016/08/new-zealand-to-upgrade-anti-submarine-warfare-capability/>.

<sup>257</sup> Quilter et al., "Launch of Capability Management System Conference Proceedings." "Underwater Intelligence Surveillance and Reconnaissance," Ministry of Defence, <https://defence.govt.nz/what-we-do/delivering-defence-capability/defence-capability-projects/underwater-intelligence-surveillance-and-reconnaissance/> (accessed 12 March, 2018).

<sup>258</sup> "The Definitions of 'Procurement' and 'Supply Chain Management'," (Chartered Institute of Procurement and Supply Chain Management, 2013), 6.

<sup>259</sup> Matthew J. Drake and Mark E. Ferguson, "Closed Loop Supply Chain Management For Global Sustainability," in *Global Sustainability Initiatives: New Modes and New Approaches*, ed. James A.F. Stoner and Charles Wankel (Charlotte: Information Age Publishing, Inc., 2008), 174.

<sup>260</sup> "The Definitions of 'Procurement' and 'Supply Chain Management'," 6.

<sup>261</sup> G, 2017.; C, 2017.

conceptually the same across each aircraft capability. However there is some variation on location, command and control, establishment structure, process and procedures, and additional functionality dependent on the specific aircraft capability the supply chain is supporting.<sup>262</sup>

While each supply chain produces similar outputs, sustainment and the organisational structure of the supply chain is largely dependent on capability type and location. The NH90/A109 supply chain provides support to both the NH90 and A109 helicopter fleets, and is located at RNZAF Base Ohakea near Palmerston North in New Zealand.<sup>263</sup> The Seasprite supply chain on the other hand is situated at RNZAF Base Auckland in New Zealand, which is also responsible for providing support to the B757-200 strategic airlift aircraft.<sup>264</sup> The aircraft capability supply chain has a core suite of outputs that are similar, but not always dependent on capability type. While there is plethora of supply chain functions carried out in the sustainment of air capability, these have been grouped into key areas and illustrated in Figure 7 below. Pivotal supply chain activities include customer facing forward support sections and stakeholder engagement, such as supplying a customer window for spares and material for maintenance, both at the main operating base, and at the forward operating bases in support of Squadron operations.<sup>265</sup> Supplier facing activities include, spares and rotatable (or line replaceable units) management and procurement; external maintenance, repairs and overhauls when an item needs to be returned to an OEM for maintenance using the suppliers' reverse logistic supply. Material requirements planning, inventory procurement and replenishment along with strategic and long-term maintenance planning at a component level also provides sustainable support to the capability.<sup>266</sup> Stakeholder engagement and relationships along with working closely with technical support elements within FSTs, are crucial to sustainment of

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<sup>262</sup> A, 2017.; B, 2017.; C, 2017; D, 2017.; G, 2017.; F, 2017.

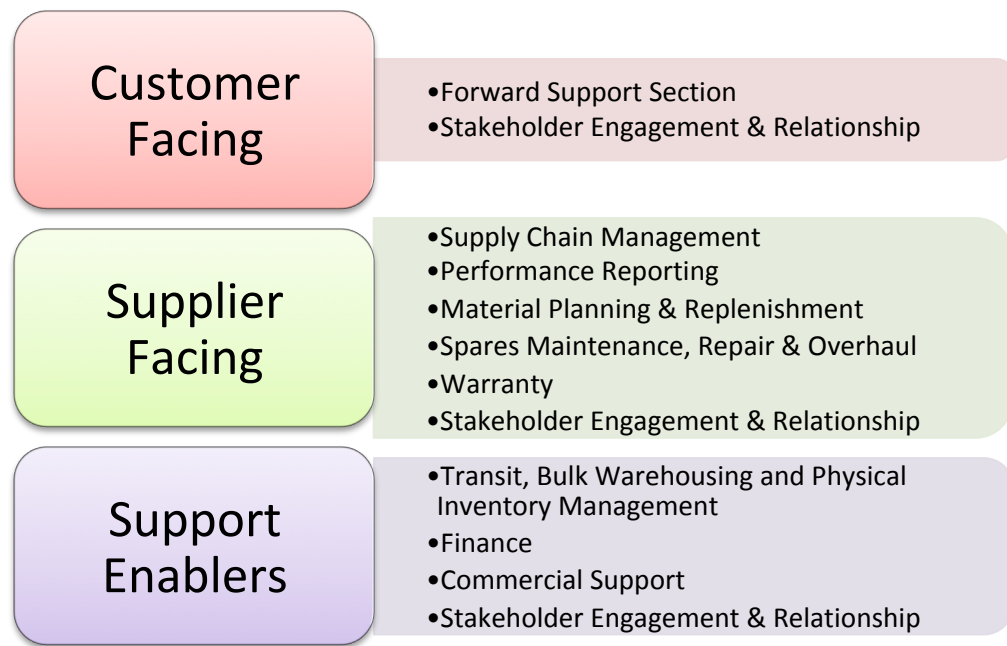
<sup>263</sup> G, 2017.

<sup>264</sup> C, 2017.

<sup>265</sup> A, 2017.; B, 2017.; C, 2017; D, 2017.; G, 2017.; F, 2017.

<sup>266</sup> Wills, "Vendor Performance Management NH90 and A109 Supply Chain," 30.

aircraft platforms. Warranty management plus performance reporting, rounds out the supplier facing functions within the supply chain.<sup>267</sup>



**Figure 7 RNZAF supply chain (based on Interviews)**

Support enablers make up the remaining functions in the supply chain, and they are critical in the successful sustainment of air capability. Enablers include warehousing and physical inventory management encompassing inwards and outwards goods functions, as well as bulk aircraft spares storage, and slow moving stock, plus packing, handling and shipping of items; budgeting and cost modelling along with commercial support also directly enables sustainment activity.<sup>268</sup> Each of these sustainment functions is key links within the supply chain, and fundamental in the ability of the RNZAF to sustain air capability through life. The effectiveness of management within the supply chain, and procurement strategies, are directly linked to strategies employed by organisations in the Product Life Cycle. The ability for a supply chain to meet customer expectations and adequately support customer demands over the Product Life Cycle, is directly influenced by

<sup>267</sup> A, 2017.; B, 2017.; C, 2017; D, 2017.; G, 2017.; F, 2017.

<sup>268</sup> A, 2017.; B, 2017.; C, 2017; D, 2017.; G, 2017.; F, 2017.

the importance placed on strategic supply chain development throughout the capability life cycle.<sup>269</sup>

The focus of this chapter has been to examine the frameworks, methodologies and academic links that support and sustain aircraft capability over the Capability Life Cycle. ILS is a crucial enabler in TLS, and the doctrinal approach that NZDF sustainment organisations are required to adhere to under the CMF in the support of major capability, such as aircraft. Studies conducted by Ward and Graves, highlights a paradigm shift in consumer demand for, and the supplier offering of, TLS products and services within the aerospace industry. Coupled with that, Lee and Edwards focus on the stimulation of consumer demand through the technological advances and intertwined intellectual property considerations of new products and capabilities, highlights the complexities organisations now face in sustaining capability. This chapter also introduces the RNZAF supply chain structure and its functions in supporting aircraft capability in the conduct of military operations. The next chapter brings together the findings that emerged from primary research interviews carried out with senior NZDF personnel, in particular the effect on the RNZAF supply chain from the acquisition and introduction of the NH90 and Seasprite helicopters.

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<sup>269</sup> "The Definitions of 'Procurement' and 'Supply Chain Management'," 3.

## Chapter 3 – Research Findings

“The question of military readiness is in large a budgetary question, since many readiness gauges can be substantially influenced by how defence resources are allocated”.

Michael E. O’Hanlon 2009 <sup>270</sup>

The preceding chapters have demonstrated that concepts such as the Product Life Cycle and the ensuing linkage to the acquisition and sustainment of aircraft capability through the Capability Life Cycle, is key to understanding effects on the RNZAF supply chain. With the possible exception of Greener’s ground-breaking study of historic Defence acquisitions, there are no published studies that are directly relating to effects on the supply chain in the RNZAF. Using the NH90 and Seasprite case studies as examples of acquisition and introduction into operational service, this demonstrates how the RNZAF supply chain is affected by first, second and third order of effects. This chapter draws on interviews conducted as part of this study with senior NZDF personnel with experience of the NH90 and Super Seasprite programmes. Despite the NH90 and Seasprite being two different aircraft at differing stages on their product life cycles, six key findings emerged which were relevant to both helicopter types. These findings transcended across both platforms and included: resource constraints, corporate knowledge and culture issues, ILS investment and ownership, product maturity and relationships. These have all created significant challenges in the sustainment and maintenance of both aircraft types.

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<sup>270</sup> Michael E. O’Hanlon, *The Science of War : Defense Budgeting, Military Technology, Logistics, and Combat Outcomes* (Princeton, N.J.: Princeton University Press in association with the Brookings Institution, 2009). 31.

The NH90 and Seasprite follow a more traditional RNZAF aircraft sustainment support model.<sup>271</sup> This is where aircraft support is being managed organically primarily by the RNZAF FSTs including the supply chain, with partial elements of Engineering, Maintenance and Supply Support also being provided by the aircraft OEMs.<sup>272</sup> RNZAF engineering personnel manage airworthiness and aircraft configuration through the enterprise resource planning system called Systems, Applications and Products (SAP). SAP is the NZDF Computer Maintenance Management System and amongst the many facets of SAP, the system includes standardised repair, maintenance and replenishment computer processing through the SAP 'plant maintenance' and 'inventory' modules, all of which are integrated with the SAP 'finance' system.<sup>273</sup> The majority of RNZAF aircraft are maintained organically at both an operational (aircraft available for tasking), and intermediate maintenance level (onsite in the hanger undergoing scheduled maintenance activity).<sup>274</sup> Organic maintenance is limited by the investment in intellectual property and capability to carry out the maintenance onsite.<sup>275</sup> Although there are subtle differences in support and sustainment activity specific to helicopter type, generic core RNZAF supply chain functions remain the same for each capability as discussed in Chapter 2. Nuances specific to aircraft type might include contractual requirements, export and other government compliance dependant on the country of original manufacture, and other environmental factors unique to each helicopter.<sup>276</sup>

There was a degree of divergence between the NH90 supply chain located at Ohakea and the Seasprite supply chain located in Auckland. Such as, where processes were not reliant on the standard SAP module requirements, there are variations between how each supply chain is carrying out support and sustainment

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<sup>271</sup> Starr et al., "Creating Value Through Integrated Products and Services in Aerospace and Defense," 14.

<sup>272</sup> C, 2017; D, 2017; G, 2017; F, 2017.

<sup>273</sup> D, 2017; F, 2017.

<sup>274</sup> *The International Traffic in Arms Regulations (ITAR): 22 C.F.R. Chapter 1, Subchapter M Parts 120-130* 17.

<sup>275</sup> D, 2017; E, 2017.

<sup>276</sup> B, 2017; C, 2017; D, 2017; G, 2017; F, 2017.

activity. Differences range between personnel establishment, through to how supply chain performance reporting is, or in some cases, is not being Primary differences include the NH90 supply chain having command and control responsibility for the forward support section (discussed in Chapter 2) and scheduled maintenance fleet planning.<sup>277</sup> Where as with the Seasprite, the scheduled maintenance planning functions are the responsibility of the separate Fleet Planning Unit, and the Forward Support Section is within the separate Logistics Support Squadron<sup>278</sup> In Auckland, both of these functions are external to the command and control of the Supply Chain Management Squadron, where the Seasprite supply chain resides.

Both helicopter types are being supported through a mix of OEM and prime vendor support for external repair. The NZDF have contracted TLS with each helicopter OEM that provides access to spares, maintenance, repair and overhaul of components, and engineering support. Additionally, both aircraft have either outsourced deeper level maintenance<sup>279</sup> requirements or have purchased expertise to carry out the function organically.<sup>280</sup> The Seasprite deeper level maintenance requirements are fulfilled through a combination of the RNZAF Aircraft Maintenance Squadron located in Auckland, and Airbus New Zealand (previously Safe Air Limited). The Aircraft Maintenance Squadron is also augmented onsite by Airbus New Zealand personnel.<sup>281</sup> Conversely, the NH90 deeper level maintenance and inspections are carried out organically in Ohakea. The NZDF opted to procure expertise in the NH90 deeper level maintenance by contracting Airbus Australia personnel to be deployed to Ohakea to augment uniformed personnel thereby creating a blended workforce. The advantage of this approach ensured that the RNZAF were not disadvantaged from a lack of depth in the corporate knowledge required to carry out deeper maintenance level tasking

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<sup>277</sup> G, 2017.

<sup>278</sup> D, 2017; A, 2017.

<sup>279</sup> Deeper or Depot Level Maintenance (DLM) is performed at a major repair facility providing repair beyond the capability of the unit (operational/flight line) or organisation (intermediate/hanger) (ITAR S120.38 Maintenance Levels) 17

<sup>280</sup> C, 2017; D, 2017; G, 2017; F, 2017.

<sup>281</sup> C, 2017; D, 2017.



due to the newness of the fleet. In turn this has meant the RNZAF have carried out the maintenance activity in the least amount of time and returned the aircraft back to service as soon as possible. Overtime, corporate knowledge gaps have reduced as the RNZAF continues to operate the aircraft and grow its depth of expertise in deeper level maintenance, with many other user nations looking inward at the RNZAF's success in their approach.<sup>282</sup>

## **Resources**

Resourcing problems are significant as the NZDF continues to march down a path of "Doing More with Less".<sup>283</sup> This philosophy has created sustainment organisations that are under pressure, and it is evident that this is creating organisational stress and culture issues that could have unforeseen consequences. For instance participants expressed that these stresses ranged from on-going change initiatives to a lack of resources. When undergoing change, the NZDF is often under-resourced with the implementation never quite getting finished or embedded properly before the organisation moves on to the next thing.<sup>284</sup> Insufficient personnel and a lack of funding also created stress through consistently having to manage competing necessary priorities to meet operational and internal maintenance requirements.<sup>285</sup> The stresses of organisational change and resource constraints factors foster an unhealthy culture. Organisational stress from continual resource churn and fiscal pressures illustrates an organisation under duress and introduces problematic human factors that could have an adverse impact on airworthiness and safety within the organisation.<sup>286</sup> The Royal Air Force (RAF) Nimrod accident over Afghanistan in 2006 is a devastating example an organisation under duress amongst a number of identified issues Such as organisational change that included initiatives to reduce cost, create efficiencies, and the resulting undesirable human factors. This was particularly prevalent

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<sup>282</sup> G, 2017; H, 2017; F, 2017; E, 2017.

<sup>283</sup> "Statement of Intent 2011-2014," 38; "New Zealand Defence Force: Progress With the Defence Sustainability Initiative," 35.

<sup>284</sup> H, 2017; B, 2017; C, 2017.

<sup>285</sup> C, 2017; B, 2017; G, 2017.

<sup>286</sup> *Safety Behaviours Human Factors : Resource Guide for Engineers*. (Australia: Civil Aviation Safety Authority 2013), 91.

within the UK Defence Logistics Organisation, which went through a significant period of organisational change between 1998 and 2006.<sup>287</sup> This included a shift in priorities towards business and fiscal targets and a push to create tri-service organisations that drove whole-of-life management of capability. This was shaped into an integrated project-based environment similar to the recently implemented IPT construct within the new Defence Capability Management System Lifecycle (discussed in Chapter 1).<sup>288</sup> The intent of the changes to the UK Defence Logistics Organisation was to bring together all the resources required to sustain capability in one hierarchy. In turn airworthiness, ILS and sustainment activities, which previously were carried out by military personnel in uniform, were outsourced to external profit driven organisations.<sup>289</sup>

With a shift in culture along with pressures from fiscal constraints that focused on cost savings, this led to human factors such as distractions and pressure as the organisation was undergoing significant change, in addition to the dilution of responsibility and accountability.<sup>290</sup> This resulted in a variety of underlying events that line up creating the ‘swiss cheese’ effect or Reason Model.<sup>291</sup> The model is a systematic approach to “identifying a sequence of multiple interacting, interrelated or interdependent elements that create a flow of events that results in a major or catastrophic accident”; such as an aircraft crash. The ‘swiss cheese’ effect was directly attributed to the catastrophic crash of the RAF Nimrod XV230, which resulted in all 14 fatalities. The Nimrod crash was a wakeup call for aviation based organisations, including the RNZAF. The NZDF sought an independent review of the Airworthiness framework in response to the release of the Nimrod report, which led to changes to the NZDF Airworthiness framework to improve

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<sup>287</sup> Haddon-Cave, "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," 355-56.

<sup>288</sup> Quilter et al., "Launch of Capability Management System Conference Proceedings."

<sup>289</sup> Haddon-Cave, "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," 355-56.

<sup>290</sup> Ibid.

<sup>291</sup> *Safety Behaviours Human Factors : Resource Guide for Engineers*, 185.

independence of airworthiness regulation and review.<sup>292</sup> The Court of Inquiry into the crash of a RNZAF Iroquois on ANZAC day 2010,<sup>293</sup> which resulted in three fatalities, one seriously injured and complete loss of the aircraft, specifically identified twelve parallels to the Nimrod crash factors, in the NZDF. At least three of those parallels resonated with the issues that have emerged from the primary research carried out in this thesis. Specifically the inclusion of “the tired and the few”, a “torrent of change and organisational turmoil”, and “cuts in resources and manpower”.

The acquisition and introduction of the NH90 and Seasprite has created fiscal and organisational pressure for the NZDF.<sup>294</sup> Sustaining military aircraft is expensive and therefore ILS becomes more costly over time. This occurs with the rapid development in technology and the increased complexity being incorporated into military products through the generational evolution. From an organisational perspective, there is a need for investment in sustainable growth and the development of in-depth corporate knowledge to combat complexity. More contemporary, complex and technical advanced capability from OEMs also increase costs of acquisition, and often to levels greater than what governments are wanting to pay within fiscally constrained defence budgets.<sup>295</sup> Added to this, whether it is operating or capital costs in nature, increased ILS cost will have a flow-on effect at a second and third level, with increased cost in spares and other supply chain elements needed to sustain upgraded or new capability.<sup>296</sup> Therefore when New Zealand plans to replace air capability, the whole of life costing will be more expensive than the capability being replaced, which requires careful consideration during the Acquisition phase.<sup>297</sup> In 1986 Norman Augustine, aerospace industrialist and previous Under Secretary to the US Army, highlights the escalating cost of procuring and sustaining aircraft when he light heartedly

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<sup>292</sup> Brian Holmes, "Key Lessons From The Nimrod Review Report: A Failure of Leadership, Culture and Priorities" (paper presented at the 2010 NZOHNA & NZISM, New Plymouth, 1-3 September 2010), 22.

<sup>293</sup> 25 April 2010

<sup>294</sup> H, 2017.

<sup>295</sup> Mark V. Arena et al., "Why Has the Cost of Fixed-Wing Aircraft Risen? A Macroscopic Examination of the Trends in U.S. Military Aircraft Costs over the Past Several Decades," ed. United States Navy and United States Air Force (RAND National Defense Research Institute and Project Air Force, 2008), XV.

<sup>296</sup> Ibid.

<sup>297</sup> Owen, "Shaping New Zealand's Airlift Force for the Next 40 Years," 10-11.

stated, "In the year 2054, the entire defence budget will purchase just one aircraft. The aircraft will have to be shared by the air force and the navy three and half days per week, except for leap year when it will be made available to the marines for the extra day".<sup>298</sup> With the magnitude of resources required and escalation in cost to acquire, support and sustain Defence capability, Government monitors projects of this nature

Major Project Reporting by Defence and the Office of the Auditor General was introduced in 2010. Both the NH90 acquisition and Maritime Helicopter Capability Projects (MHCP) feature due the project values being in excess of NZ\$15 million New Zealand dollars. Reports provide Government with status updates and highlights performance against identified risks and expected benefits from major military capability projects. The NH90 acquisition is a \$772 million New Zealand dollars programme, whereas the MHCP is a \$252 million New Zealand dollars acquisition.<sup>299</sup> While Government audit reports highlight the significant cost involved in procuring air capability, in reality the NZDF have found true sustainment and support costs for the NH90 and Seasprite requiring more resourcing in certain areas.<sup>300</sup> In the case of the NH90, additional capital investment in additional spares for impending major deeper level maintenance requirements is needed.<sup>301</sup> The additional investment in spares is a trend that other nations such as Finland and Australia have also experienced.<sup>302</sup> In the case of the Seasprite, additional annual operational expenditure was estimated by the project, however there was no additional funding provided to the supply chain to meet the additional TLS costs. The supply chain has found itself in a position where annual repair and maintenance budgets are insufficient to cover scheduled known maintenance activity let alone the ability to meet urgent unscheduled maintenance

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<sup>298</sup> Arena et al., "Why Has the Cost of Fixed-Wing Aircraft Risen? A Macroscopic Examination of the Trends in U.S. Military Aircraft Costs over the Past Several Decades," XV. Augustine R. Norman, *Augustine's Laws*, 6th ed. ed. (New York: Viking Penguin, 1986). 143.

<sup>299</sup> "Major Projects Report 2016," 29, 42.

<sup>300</sup> C, 2017; G, 2017; B, 2017; F, 2017.

<sup>301</sup> G, 2017; E, 2017.

<sup>302</sup> McNally, Linard, and Turnbull, "Multi-Role Helicopter Program; G, 2017; F, 2017; Suila, "Finland's Helicopter Program."

events that arise.<sup>303</sup> Additionally, both platforms are experiencing obsolescence issues such as sourcing hard to find spares for Seasprite systems no longer being manufactured, or on-going product design changes in the NH90, which is placing further pressure on the tight budgets.<sup>304</sup>

### **Corporate Knowledge and Culture**

This is an area that is not well-documented in scholarly or industry resources, however the study's interview participants have been able to highlight how NZDF organisational issues such as Command and Control, culture, a shallow depth of corporate knowledge, were all areas of concern.<sup>305</sup> Despite the reviews of the past that have shaped the CMF of today, the whole-of-life approach continues to struggle beyond Introduction-Into-Service phase within Defence. In particular, the In-Service phase is suffering as a result of the NZDF Command and Control matrix, the intent of the FST has been lost, and the application of career management policy.<sup>306</sup> Firstly, it would appear that issues with Command and Control are a complicating factor. For example the cross-functional matrix style of Command and Control within the NZDF constrains the ability of those within the matrix to control the application of NZDF doctrine and best practice thinking early in the capability life cycle.<sup>307</sup> This has a flow on effect that impacts the In-Service phase,<sup>308</sup> such as there is no one Command Chain that is accountable for the TLS of air capability.<sup>309</sup> This makes it very difficult to manage the resources required to effectively and efficiently sustain capability, and further more creates grey areas of accountability and responsibility, including where these activities start and stop. In addition, it becomes unclear which part of the organisation needs to be consulted and who needs to be informed.<sup>310</sup>

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<sup>303</sup> B, 2017; C, 2017.

<sup>304</sup> C, 2017; G, 2017.

<sup>305</sup> B, 2017; C, 2017; D, 2017; G, 2017; H, 2017; F, 2017.

<sup>306</sup> B, 2017; C, 2017; D, 2017; G, 2017; H, 2017; F, 2017.

<sup>307</sup> H, 2017.

<sup>308</sup> B, 2017.; H, 2017.

<sup>309</sup> A, 2017.; B, 2017; C, 2017; H, 2017.

<sup>310</sup> B, 2017; C, 2017.

The formal transition of ownership of aircraft capability support and sustainment throughout the stages of the Capability Life Cycle can be problematic. Difficulties arise because there is no one area of ownership that controls the flow or resources across the entire cycle which then creates ambiguity in the lines of responsibility at the lower levels such as the supply chain.<sup>311</sup> This is particularly prevalent when transitioning aircraft from Introduction-Into-Service to In-Service where the length of time it takes to introduce an aircraft into service can be years, therefore the NZDF often release interim capability during the introduction phase. This creates ambiguity as the aircraft may be partially in operational service, while introduction activity is still being carried out concurrently.<sup>312</sup> This was demonstrated with the Seasprite, where there has been a partial formal transition of the capability to In-Service at the time of writing which at times made it confusing for the Seasprite chain on whether it was the project or In-Service area that was responsible when it came sustainment and support activity.<sup>313</sup> If Defence was to invest resources to establish the Responsible, Accountable, Consult and Inform (RACI)<sup>314</sup> approach at a task level, this would help reduce the issues. The purpose of RACI is to identify and empower who is responsible for doing the work, which is the one person ultimately accountable for achieving the output, who needs to be consulted, and who needs to be kept informed.<sup>315</sup> This approach would augment and facilitate robust and enduring capability support and sustainment systems, through clear lines of command and communication.<sup>316</sup>

Secondly, the RNZAF has embraced FSTs to create efficiencies and promote integration in sustainment. The fleet support construct is a relatively new initiative, which was implemented in 2012.<sup>317</sup> The FST concept comprises supply

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<sup>311</sup> A, 2017; B, 2017; H, 2017.

<sup>312</sup> Charles Haddon-Cave, "Leadership & Culture, Principles & Professionalism, Simplicity & Safety – Lessons from the Nimrod Review" (paper presented at the RUSI of ACT at the Australian Defence College, Australia, 09 April 2014), 3.

<sup>313</sup> A, 2017; B, 2017; H, 2017.

<sup>314</sup> Bolstorff and Rosenbaum, *Supply Chain Excellence a Handbook for Dramatic Improvement Using the SCOR Model*: 150.

<sup>315</sup> Ibid.

<sup>316</sup> Quilter et al., "Launch of Capability Management System Conference Proceedings."

<sup>317</sup> B, 2017.; D, 2017.

chain personnel and their technical support peers, co-located and working together supporting and sustaining RNZAF capability. Stakeholder engagement spans the operators and force elements, maintenance, finance, commercial and other support enablers, all of which are critical to and augments the FST approach. The purpose of the FSTs is to create a more cohesive ILS approach and create efficiencies through joint supply and technical process review and development. However the FSTs were never fully implemented as intended at inception, and as a result the intent has been lost over time as personalities and personnel have changed in key roles and the original instigators have moved on.<sup>318</sup> While the FSTs are still co-located in either Auckland or Ohakea, and they have a strong relationship and regularly communicate with each other, there has been very little advancement in further structured integration of the teams or review and development of sustainment processes to identify potential efficiencies, which has been exacerbated by resource constraints. The positive work that is taking place is generally driven by individual personalities while the holistic strategic intent has been lost.<sup>319</sup>

Lastly, career management within the RNZAF usually operates on a general posting plot of shifting uniformed personnel to different posts in a two to three year cycle.<sup>320</sup> While from a career progression point of view, this policy usually ensures that operational and non-operational Service needs are met on a rotational basis; it also creates a progression path to build the required experience and skill-set for eligibility for promotion.<sup>321</sup> When human resources are not suitably qualified or experienced, and combined with other sustainment variables, there can be consequences that have flow on impacts. The posting cycle creates a negative effect on the depth of knowledge especially when there are insufficient personnel to meet all of the outstanding vacancies.<sup>322</sup> For example where personnel responsible for sustainment either have a very shallow level of knowledge or understanding of

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<sup>318</sup> B, 2017.; D, 2017.

<sup>319</sup> G, 2017; B, 2017; C, 2017; F, 2017.

<sup>320</sup> C, 2017.

<sup>321</sup> G, 2017.

<sup>322</sup> D, 2017.

the why activities are carried out in the way they are, or they are constantly trying get up to speed if just posted into sustainment areas such as the supply chain, this creates additional stress on areas by constraining their ability to provide the expected support.<sup>323</sup> Resources can be constrained either by personnel number caps, incorrect establishment, or lack of uniformed personnel to fill vacancies, along with the previous initiative to shift from a uniformed to civilian based utilisation (discussed in Chapter 1). Ultimately a 'tipping point'<sup>324</sup> is reached when all of the gaps line up and issues such the posting cycle create, or risk creating unwanted second and third order of effects.<sup>325</sup> The biggest risk becomes the dilution of corporate knowledge of the capability being supported and the theories behind supporting capability.<sup>326</sup>

Corporate knowledge is lost over time due to the posting cycle policy, which is exacerbated by the introduction of new military capability.<sup>327</sup> When introducing new aircraft into service, the complexity and maturity of that aircraft product life cycle dictates the level of subject matter expertise required.<sup>328</sup> The organisation can no longer rely on ex-military personnel in the general labour market with corporate knowledge of the aging RNZAF aircraft, which historically the NZDF have been able to tap into to address shortfalls.<sup>329</sup> As uniformed personnel are posted to areas responsible for sustaining capability, this often requires a depth of knowledge and expertise specific to the capability type. If military personnel do not have the requisite knowledge on arrival into their role, it is often learnt on the job, and just as they are getting to the point where they are developing that depth required over a two to three year posting period, they are posted again and the cycle repeats itself. Because of this, units are often losing access to that valuable corporate knowledge and have to reinvest in both time and effort taking precious

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<sup>323</sup> Ibid.

<sup>324</sup> Malcolm Gladwell, *The Tipping Point : How Little Things Can Make a Big Difference*, Paperback ed. (Boston: Back Bay Books, 2002).

<sup>325</sup> D, 2017.; B, 2017.; G, 2017.

<sup>326</sup> D, 2017.; H, 2017.

<sup>327</sup> B, 2017.; D, 2017. "The Defence Sustainability Initiative: Building a Long-Term Future for the New Zealand Defence Force," (Wellington: Ministry of Defence, 2005), 5.

<sup>328</sup> B, 2017.; D, 2017.

<sup>329</sup> "New Zealand Defence Force: Progress With the Defence Sustainability Initiative," 17.



resources away from sustaining capability, to re-grow the lost knowledge as new personnel are posted into the environment.<sup>330</sup> In the case of new air capability the RNZAF just cannot rely on buying expertise off the street in New Zealand. There is very little if any availability of suitably qualified and experienced people skilled in supporting or sustaining either the NH90 or Seasprite. With the NH90 initial release of operational capability occurring in March 2014, and then in April 2016 for the Seasprite, both helicopters have been service less than five years at the time of writing.<sup>331</sup> During this period, the personnel attrition rate across the entire NZDF was less than 10%.<sup>332</sup> This in conjunction with the RNZAF posting cycle, the pool of ex-Service personnel suitable in external labour market is likely to be small and generally difficult to recruit the right resources from. Equally there are no other operators of these aircraft types within New Zealand, which makes it even more difficult to tap into the local labour market.<sup>333</sup>

### **Integrated Logistic Support**

The ILS framework provides structure to capability sustainment in line with NZDF doctrine, and is very specific. Doctrine directs the consideration and implementation of effective and efficient ILS throughout the Capability Life Cycle. Whatever the major capability acquisition, ILS concepts have to be treated as paramount and at the forefront rather than a burden,<sup>334</sup> and must follow throughout each phase of the Capability Life Cycle rather than just at Acquisition or Introduction-Into-Service stages. Evidence suggests that the NZDF continues to carry out ILS poorly in spite of integrated logistics being a key component of TLS and Whole of Life doctrine.<sup>335</sup> Possibly this is occurring due to a lack of 'buy in' to the concept and insufficient resourcing to ensure that ILS becomes ingrained in the

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<sup>330</sup> F, 2017.

<sup>331</sup> "Major Projects Report 2016," 115; D, 2017.

<sup>332</sup> "The Defence Sustainability Initiative: Building a Long-Term Future for the New Zealand Defence Force," 5-6; "New Zealand Defence Force: Progress With the Defence Sustainability Initiative," 17,19.

<sup>333</sup> "The Defence Sustainability Initiative: Building a Long-Term Future for the New Zealand Defence Force," 5-6; "New Zealand Defence Force: Progress With the Defence Sustainability Initiative," 17,19.

<sup>334</sup> H, 2017; Jones, *Integrated Logistic Support Handbook*: xiii.

<sup>335</sup> H, 2017.

culture of the organisation, and all aspects of the Capability Life Cycle.<sup>336</sup> As Jones points out, it is fundamental for organisations to fully embrace and invest in ILS at system design level, the purpose of which is to reduce costly effects downstream if logistics becomes an after-thought.<sup>337</sup> An organisation that fully embraces the importance of ILS across all stages of the Capability Life Cycle can directly influence the ability to effectively and efficiently provide support to capability and thereby minimise whole of life cost for the Government.<sup>338</sup> Whether it is by choice or by circumstance, rather than taking an all-phases approach, the focus within NZDF has been primarily on ILS in Acquisition and Introduction-Into-Service stages. This has left the In-Service phase in somewhat of an awkward position as resource-constrained functional units within that environment are expected to take on the ILS responsibility.<sup>339</sup>

Prior to 2006, there was a realisation that the ILS in capability acquisition projects was done poorly and could be improved upon by the NZDF. Recognising the need to improve the implementation of ILS was the catalyst to establishing a NZDF ILS Centre of Expertise.<sup>340</sup> ILS is a key component of supporting capability, which is implemented alongside PRICIE when acquiring and sustaining military capability over the Capability Life Cycle.<sup>341</sup> While PRICIE (discussed in Chapter 1) addresses capability Mission Systems, ILS deals with the Support Systems and is supposed to consider the whole life of the capability.<sup>342</sup> With a mandate to write policy, and provide training, ILS guidance and expertise, the ILS Centre of Expertise was resourced with two full-time personnel. Over time the outputs of this Centre have increased to include ILS assurance to Capability Management Steering Groups and Management Boards, which are governing mechanisms for major capability projects.<sup>343</sup> However with the additional requirements on the Centre, along with

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<sup>336</sup> G, 2017; H, 2017; F, 2017; E, 2017.; B, 2017.; C, 2017.

<sup>337</sup> *Integrated Logistic Support Handbook*: xiii.

<sup>338</sup> Ibid., 1.6. "Integrated Logistics Support in Capability Management Handbook," 3.

<sup>339</sup> B, 2017.; C, 2017.; H, 2017.

<sup>340</sup> H, 2017.

<sup>341</sup> "ILS Framework Overview for Projects/Programmes Greater Than \$15m," 11.

<sup>342</sup> "Integrated Logistics Support in Capability Management Handbook," 5-6.

<sup>343</sup> H, 2017.

no increase in resourcing, and expanding pressures in the major capability project space, the ability for the Centre to adequately meet its remit may need to be questioned.

It is apparent that funding and personnel resources within the NZDF ILS Centre of Expertise are spread too thinly. Organisational resistance within New Zealand Defence agencies to fully embrace ILS and invest in the framework at high levels of the organisation, has meant the Centre has been unable to give one hundred percent to all areas that need their ILS expertise. Instead the Centre has had to prioritise scarce resources in an effort to get the maximum 'value-for-money' and therefore has focussed the majority of their efforts on the Acquisition and Introduction-Into-Service phases in major capability procurement.<sup>344</sup> This however has had first, second, and third order of effects within the NZDF, such as in the In-Service stage of the Capability Life Cycle. For example, business-as-usual units in the In-Service phase are left to struggle with no one section or area of Command taking ownerships for ILS. Additionally many personnel are not trained or experienced in, nor do they understand the ILS methodology, and equally personnel do not know what the ILS framework looks like in practice, or how to apply it.<sup>345</sup> With insufficient importance placed on ILS, the critical mass of trained ILS specialists needed to change acceptable norms and culture within the NZDF does not occur or exist.<sup>346</sup>

Generation of personnel who are suitably qualified and experienced in ILS is not done well in the NZDF.<sup>347</sup> With no dedicated path to gain academic knowledge and develop a depth of project expertise and in-service experience, cracks appear and the framework erodes. With insufficient critical mass, and a military posting cycle that moves personnel from job to job every two to three years, people are posted to positions that require ILS expertise, and are reliant on on-the-job training.<sup>348</sup>

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<sup>344</sup> Ibid.

<sup>345</sup> B, 2017.; D, 2017.; G, 2017.; C, 2017.

<sup>346</sup> H, 2017.

<sup>347</sup> Ibid.

<sup>348</sup> Ibid.

This then creates further issues as they learn habits of the past, and not always good ones at that, as they repeat what has been done on previous projects.<sup>349</sup> For example this was stressed in multiple interviews where participants described their lack of knowledge of ILS within the In-Service stage as “what does ILS look like in in-service”, or “I have had no training in ILS and have only an awareness of the term”, and “we don’t know what we don’t know”.<sup>350</sup> The NZDF ILS Centre of Excellence facilitates six-monthly ILS courses but there is no mandate making it compulsory for personnel responsible for capability sustainment In-Service to participate in these training initiatives.<sup>351</sup> Personnel in project specific ILS roles do attend a week or two long training course at some stage in their first six months in the job, but this does not give them the depth required to effectively and efficiently develop the ILS concepts required to establish and sustain major aircraft capability over all phases of the Capability Life Cycle.<sup>352</sup> Often by the end of the three-year posting cycle, personnel in project roles become proficient but then they are moved on rather than re-invested in other ILS areas.<sup>353</sup> Personnel within the In-Service stage are required to continue muddling their way through.<sup>354</sup>

The formal transition of the ILS framework from Acquisition through to In-Service can be problematic. There is insufficient investment in developing the ILS philosophy and acceptance within the In-Service phase, and this is exacerbated by the NZDF matrix, which is often challenging and complex to navigate.<sup>355</sup> The In-Service units responsible for sustaining the capability are supposed to become accountable and responsible for managing, monitoring or modifying the ILS arrangements and process until disposal.<sup>356</sup> The goal is to ensure an enduring “optimised Support System, that is in the right place at the right time, the right specification, at the right quantity to support and sustain the capability” over the

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<sup>349</sup> Ibid.

<sup>350</sup> A, 2017; B, 2017; C, 2017; G, 2017.

<sup>351</sup> H, 2017.

<sup>352</sup> Ibid.

<sup>353</sup> Ibid.

<sup>354</sup> Ibid.

<sup>355</sup> B, 2017.; D, 2017.; G, 2017.; C, 2017.

<sup>356</sup> B, 2017.; D, 2017.; G, 2017.; C, 2017.

life of the capability.<sup>357</sup> To achieve this goal, the ILS concepts and plans implemented during earlier stages of the Capability Life Cycle are utilised. The ILS plan is subordinate to the NZDF Capability Management Plans, and details the capability's programme of support, identifies stakeholders, and articulates commercial arrangements.<sup>358</sup> While on paper the high level transfer of accountability and responsibility within the CMF from Acquisition to In-Service has the appearance of smooth transition from stage to stage, this is not occurring in reality.<sup>359</sup>

Both the NH90 and Seasprite supply chains suffer from gaps and transition of the ILS knowledge once the aircraft was introduced into service.<sup>360</sup> Research gathered through primary interviews for this thesis, highlighted that one of the key problems was that there was no formal standardised RACI mechanism to hand over the ILS plan and other artefacts to business as usual ownership.<sup>361</sup> As a result, the efforts being made to address ILS concepts and produce the required artefacts during Acquisition through to Introduction-Into-Service, are being suffocated at the end of Introduction-Into-Service-stage. For example, documentation including the ILS plans have been stalled in their formal transition from Acquisition through to the In-Service phase because there is no one chain of Command that controls the resources to deliver all aspects of ILS, and there is no NZDF policy on which unit takes ownership of ILS and its artefacts inside the matrix once In-Service.<sup>362</sup> Furthermore, there is no formal or standardised mechanism across the NZDF to periodically review, update and approve holistic changes to the capability ILS concepts and artefacts once In-Service.<sup>363</sup> While in reality common sense is being

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<sup>357</sup> "Integrated Logistics Support in Capability Management Handbook," 4.

<sup>358</sup> "ILS Framework Overview for Projects/Programmes Greater Than \$15m," 11.

<sup>359</sup> H, 2017.

<sup>360</sup> B, 2017; C, 2017; G, 2017; H, 2017.

<sup>361</sup> C, 2017; H, 2017.

<sup>362</sup> D, 2017; H, 2017.

<sup>363</sup> D, 2017; H, 2017.

applied when sustaining the capability In-Service, but this is being done in an *ad hoc* manner with little or no depth of training or experience in ILS methodology.<sup>364</sup>

Despite ILS challenges faced at an organisational level, the NH90 supply chain has played a crucial role in developing the MyNH90 ILS portal with NHI. Due to the size of the NH90 fleet and volume of transaction, New Zealand was selected as a trial country for the MyNH90 portal programme which was in development soon after the NZDF commenced NH90 operations. Participants stressed that this was a valuable opportunity for the supply chain to shape the software into a supply chain tool that would work well for New Zealand as well as other nations.<sup>365</sup> While teething problems were experienced at the beginning with performance, and utility, over the last few years the NH90 supply chain has sought to improve the MyNH90 portal functionality through testing and implementing New Zealand-influenced developments and enhancements, such as improved performance, reporting templates, smoother transactional process, and customer interface.<sup>366</sup> The capability is now at a point where all external maintenance, repair and overhaul activity, as well as material procurement, occurs through the portal, and more and more nations are being brought online.<sup>367</sup> This initiative has proven to be very valuable to the sustainment of the NH90 within the supply chain.

The In-Service phase is the 'customer facing' end of ILS initiatives, which often bears the brunt if insufficient investment is placed on the importance of its role in capability sustainment. While there are RNZAF and NHI ILS initiatives occurring with the MyNH90 portal activity, this is an independent initiative outside of the NZDF ILS framework. Therefore as outside experts, such as James Jones has emphasised, it is very important to immerse suitably qualified and experienced ILS personnel into the early phases of the capability life cycle to ensure support can

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<sup>364</sup> *Integrated Logistic Support Handbook*: 1.7; C, 2017; G, 2017.

<sup>365</sup> B, 2017; D, 2017; H, 2017.

<sup>366</sup> F, 2017.

<sup>367</sup> "The NH90 Joins the Digital Marketplace Part by Part," Airbus, <http://www.airbus.com/newsroom/news/en/2017/11/the-nh90-joins-the-digital-marketplace--part-by-part.html> (accessed 11 March, 2018); "Royal New Zealand Air Force," in *NH90 User Group* (Buckeburg: New Zealand Defence Force, 2014), 22; F, 2017.

occur effectively and efficiently In-Service.<sup>368</sup> With the right expertise, early thinking is shaped and concept decisions are influenced using a robust systems-based approach. While political and strategic influences may also shape the direction of a project and capability acquisition. Personnel with a depth of knowledge and expertise in ILS will be able to contribute a justified position when determining sustainment models to ensure the Defence and the New Zealand Governments needs are met. However, when there are inexperienced ILS personnel, or no ILS presence at all, how capability is sustained In-Service is often skimmed over in the early stages.<sup>369</sup> Equally, decisions focussed on funding without the right ILS input, can sway the ILS and sustainment concepts of the capability in ways that increases risk of ineffective support and missed opportunities to generate long-term efficiencies and 'value-for-money' choices.<sup>370</sup> As a result this then creates potential gaps in support that need to be plugged once the aircraft is introduced into service.<sup>371</sup>

## **Product Maturity**

Product maturity as well as strategic focus of an OEM and their intellectual property (IP), have placed NZDF in a difficult position: Problems with the immature nature of both the NH90 helicopter design versus the more mature Seasprite design, is creating a bumpy path for the supply chain to navigate. Complexities such as IP also influences how capability is supported. A suppliers internal strategy dictating whether IP will be released to customers for organic maintenance and sustainment utilisation determines the type of ILS arrangements that are established to support the capability.<sup>372</sup> Access to OEM IP directly enables the NZDF's sustainment models to support platform complexity.<sup>373</sup> Navigating supplier IP strategies is critical to influencing inventory and spares philosophy,

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<sup>368</sup> *Integrated Logistic Support Handbook*: 1.7, 3.2; H, 2017; D, 2017.

<sup>369</sup> B, 2017; H, 2017.

<sup>370</sup> B, 2017; H, 2017.

<sup>371</sup> Haddon-Cave, "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," 371, 405.

<sup>372</sup> Lee Ann Tegtmeier, "Military Sustainment in Western Europe," *Aviation Week Overhaul & Maintenance*, no. July/August (2009): 52.

<sup>373</sup> Paul Seidenman and David Spanovich, "Reconfiguring Avionics Support," *Aviation Week Overhaul & Maintenance*, no. May (2012): 18.

time-to-repair, as well as organic versus OEM maintenance decisions.<sup>374</sup> IP access also dictates personnel skill set and knowledge requirements, as well as the level of investment in IP required by Defence.<sup>375</sup> All of these factors have contributed to a growing number challenges in the sustainment the NH90 and Seasprite fleets. The tenuous nature of the challenges faced is shown by an incident in August 2013 when the RNZAF experienced a lightning strike on a NH90 while it was in flight.<sup>376</sup> This event exhausted the spares on hand to return the aircraft to flight worthy state, after it experienced significant damage in many key sections of the helicopter illustrated in Figure 8 below. The NZDF was left with a costly and lengthy exercise to repair or replace damaged systems. At the time, due to the significance of the event, NHI did prioritised New Zealand's efforts to bring the aircraft back to serviceability.<sup>377</sup>



Figure 8 Lightning Strike Damage to NH90<sup>378</sup>

<sup>374</sup> Tegtmeier, "Military Sustainment in Western Europe," 52.

<sup>375</sup> C, 2017; F, 2017; D, 2017; E, 2017; G, 2017.

<sup>376</sup> Lloyd Burr, "The Aftermath of an Air Force NH90 Lightning Strike," MediaWorks TV, <http://www.newshub.co.nz/nznews/the-aftermath-of-an-air-force-nh90-lightning-strike-2016092716> (accessed 14 November, 2016).

<sup>377</sup> F, 2017.

<sup>378</sup> NZDF, "Burr's Article: The Aftermath of an Air Force NH90 Lightning Strike includes Photograph of Damage to NZ3301 Supplied by the New Zealand Defence Force and Released Under the Official Information Act," in *News Hub* (Auckland: MediaWorks TV, 2016).



There was an intangible price to pay in addition to repair cost. As spares were returned to NHI, it was evident that the magnitude and significance of the event was not something NHI had been faced with previously therefore the product maturity of the NH90 became an issue where repair schemes did not yet exist for many of the unserviceable items.<sup>379</sup> The incident was the first time a NH90 had been struck by lightning while flying, damaging main and tail rotor blade areas of the aircraft, and costing the New Zealand Government in aircraft availability, and almost five million New Zealand dollars to repair.<sup>380</sup> It can be deduced from press releases, and primary research interviews, and given the difficulty in sustaining an adequate number of spares for day-to-day operations, the lightning strike would have been unexpected and would have placed pressure on the supply chain. It is likely this manifested itself in both cost and the spares pool availability, which then impacted the ability to adequately maintain and sustain the rest of the NH90 fleet. However what it also highlighted was that because this type of event had not occurred previously, the lack of product maturity meant some damage could not be repaired in a timely manner due to either a lack of repair schemes, or the depth and the length of time it took for engineering investigations to occur to determine levels of damage at a component level, and how to repair them.<sup>381</sup>

Product maturity of the both the NH90 and Seasprite helicopters has become a significant driver in the sustainment of both aircraft types. While diametrically opposite as to which phase of the Product Life Cycle both helicopters sit in, their positions on the life cycle create similar challenges for the NZDF. The first flight of the NH90 prototype occurred on December 18<sup>th</sup> 1995,<sup>382</sup> but mass production of the NH90 only began in 2000.<sup>383</sup> At the opposite end of the spectrum, the prototype Super Seasprite was first flown by the US Navy in 1985, and a fleet of 16

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<sup>379</sup> F, 2017.; G, 2017.

<sup>380</sup> Burr, "The Aftermath of an Air Force NH90 Lightning Strike".

<sup>381</sup> F, 2017.; G, 2017.

<sup>382</sup> "First Flight of the NH90," NH Industries, [http://www.nhindustries.com/publications/en/ref/FIRST-FLIGHT-OF-THE-NH90-HELICOPTER\\_289.html](http://www.nhindustries.com/publications/en/ref/FIRST-FLIGHT-OF-THE-NH90-HELICOPTER_289.html) (accessed 14 October, 2017).

<sup>383</sup> "Reporting the Progress of Defence Acquisition Projects: Interim Report, June 2008," 37.

entered into service in 1993.<sup>384</sup> Originally born from the UH-2A prototype, the SH-2G Seasprite (US variant) was officially withdrawn from service by the US Navy in 2001,<sup>385</sup> years before the first NH90 production aircraft reached its first customer.<sup>386</sup> A total of 200 Seasprites were produced in its lifetime. Reducing fleet numbers and a small number of users including New Zealand and Australia, the Egyptians, and the Polish.<sup>387</sup> New Zealand took delivery of ten previously owned Australian versions in 2015,<sup>388</sup> in 2014 the Peruvians purchased the old 'NZ' variants subsequently contracted Kaman Aerospace to upgrade four of the old 'NZ' variants to the Seasprite configuration. With no more than 28 aircraft now operating globally, the Seasprite is rapidly reaching the end of its Production Life Cycle.<sup>389</sup> Conversely as at May 2013, NHI had 529 orders for helicopters covering a number of variants across 14 nations.<sup>390</sup> After years of production delays, the first production NH90 helicopter was delivered to Germany on the 13<sup>th</sup> December 2006;<sup>391</sup> New Zealand took delivery of two aircraft in December 2011<sup>392</sup> and the remaining 6 in various instalments with the last two arriving in October 2014.<sup>393</sup> NHI reached a significant milestone when it delivered the 300<sup>th</sup> production helicopter to Spain in December 2016, over 20 years since the first flight.<sup>394</sup>

The immaturities of the NH90 design in the early stages of the helicopter product life cycle frustrated many user nations. With the first flight having taken place in

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<sup>384</sup> "Kaman SH-2 Seasprite/Super Seasprite Ship-Based Anti-Submarine Warfare (ASW) Helicopter," Military Factory, [https://www.militaryfactory.com/aircraft/detail.asp?aircraft\\_id=279](https://www.militaryfactory.com/aircraft/detail.asp?aircraft_id=279) (accessed 23 October, 2017).

<sup>385</sup> "SH-2G Super Seasprite Anti-Submarine Helicopter, Australia," Naval-technology.com, <http://www.naval-technology.com/projects/sh2g-super-seasprite/> (accessed 14 October 2017).

<sup>386</sup> Ibid. Suila, "Finland's Helicopter Program."

<sup>387</sup> "Kaman SH-2 Seasprite/Super Seasprite Ship-Based Anti-Submarine Warfare (ASW) Helicopter", 8.

<sup>388</sup> "Major Projects Report 2016," 39.

<sup>389</sup> "SH-2G Super Seasprite Anti-Submarine Helicopter, Australia".

<sup>390</sup> "NH90 Programme and JMAAN Organisation," 5.

<sup>391</sup> "Eurocopter Hands Over the First Three NH90 to the German Army," Defence\_Aerospace.com, [http://www.defense-aerospace.com/articles-view/release/3/76742/eurocopter-delivers-first-three-nh\\_90s-to-germany.html](http://www.defense-aerospace.com/articles-view/release/3/76742/eurocopter-delivers-first-three-nh_90s-to-germany.html) (accessed 14 October, 2017).

<sup>392</sup> "First NH90 Helicopters Arrive," *Air Force News*, no. 133 (2012): 11.

<sup>393</sup> "Major Projects Report 2016," 25.

<sup>394</sup> Aeromorning, "NH90 Program Passes Major Milestone with Delivery of 300th Production Helicopter to the Spanish Customer," <http://www.aeromorning.com/en/nh90-program-passes-major-milestone-with-delivery-of-300th-production-helicopter-to-the-spanish-customer/> (accessed 14 October, 2017).

1995, customers such as Finland and Australia, had expected the aircraft to be far more advanced than it was. In a report commissioned by the Finnish Ministry of Defence, authors purported that NHI never expected the sales of the NH90 to be so successful so early and was not established sufficiently to satisfy customer demand.<sup>395</sup> NHI proposed that instead of the Finnish contracted final design, the aircraft would be delivered in an Initial Operational Configuration (IOC-), then retrofitted to the Nearly Final Operational Configuration (IOC+), and lastly upgraded to a Final Operational Configuration (FOC). While Finland agreed to this approach, variations were made to their Acquisition Contract and the Finnish Government was compensated.<sup>396</sup> Germany too was suffering issues with the delivery of their NH90 programme. In February 2010 a 'secret report' was leaked to the German daily paper Der Bild that claimed there were design and technical issues with cabin configuration, seating size, winch capability and a lack of robustness of the floor making it prone to damage.<sup>397</sup> In an interview with NHI's Dr Schley, Vice President and NAHEMA Programme Coordination Manager from Eurocopter, he acknowledged the 'secret report' and responded that the report was relevant only to the German Initial Operational Capability (IOC)<sup>398</sup> Furthermore, the IOC has gone through a number of design enhancements that have been implemented in the Final Operational Capability (FOC) which was undergoing certification at the time of the interview, and was due to be delivered to Germany in the following year.<sup>399</sup>

Since NHI missed their first 2003 NH90 delivery date for the Germans, NHI has been plagued with production delays, certification and design issues, and customer

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<sup>395</sup> Suila, "Finland's Helicopter Program," 8.

<sup>396</sup> Ibid., 7.

<sup>397</sup> Jean-Francois Lintanff, "Interview with Dr Schley, VP & NAHEMA Progr. Coord. Manager, Eurocopter," Delege Regional, TLF - Ile-de-, <http://fr.viadeo.com/fr/groups/detaildiscussion/?containerId=002159fj8yppl5m1&forumId=0025znw07pnoweit&action=messageDetail&messageId=0021r88ml1s57x5h> (accessed 23 October, 2017).

<sup>398</sup> German describe the configuration of their NH90s in Initial and Final Operational Capability whereas Finland describes the configuration of their NH90s as Initial, Nearly Final and Final Operational Configuration and not capability.

<sup>399</sup> Lintanff, "Interview with Dr Schley, VP & NAHEMA Progr. Coord. Manager, Eurocopter".

dissatisfaction.<sup>400</sup> Some NH90 user governments are closely monitoring their NH90 projects as high risk, a number of which have already resulted in commercial compensation.<sup>401</sup> While it is generally accepted the capability the NH90 delivers as a medium utility helicopter is very good, the design supportability and life cycle costs at this stage in the Product Life Cycle are proving problematic and difficult to sustain. Like Finland, Germany, and Australia, the Netherlands too was experiencing issues with delays and design. The Netherlands is experiencing significant corrosion issues in the maritime environment hinting at teething problems with the maritime variant operating design.<sup>402</sup> Australia openly criticised the NH90 programme in the 2013 ANAO report to the Australian Government outlining issues. NHI ultimately ended up compensating Australia by providing a forty-seventh aircraft to resolve Acquisition Contract disputes. As per other nations, the report also highlighted product maturity and design issues.<sup>403</sup>

New Zealand was not immune to the global fleet issues arising from product life cycle immaturity. After the first delivery of aircraft to New Zealand shores, the NH90 began its transition into service at RNZAF Base Ohakea. It quickly became evident that the lack of product maturity created a number of problems not anticipated.<sup>404</sup> Firstly, with limited IP there were a significant increase number of technical queries lodged with NHI to access information required to maintain and operate the aircraft. For example, between February 2012 and August 2016 there were 1130 requests for technical assistance with an average of six per week in 2016.<sup>405</sup> Equally when there was a maintenance issue, or design change which then needed to be carried out on the NH90, notification and rectification would be through the issue of a Service Bulletins (SB) by NHI. The SB would contain the

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<sup>400</sup> "Germany Not Happy with NH90 Helicopter".

<sup>401</sup> McNally, Linard, and Turnbull, "Multi-Role Helicopter Program; Suila, "Finland's Helicopter Program; Lintanff, "Interview with Dr Schley, VP & NAHEMA Progr. Coord. Manager, Eurocopter".

<sup>402</sup> "Helicopter Corrosion Maintenance Prediction Using Environmental Sensors."

<sup>403</sup> McNally, Linard, and Turnbull, "Multi-Role Helicopter Program," 16-17. *ibid.*, 22.

<sup>404</sup> G, 2017; F, 2017.

<sup>405</sup> Luke Elliott, (paper presented at the RNZAF Engineers Forum, RNZAF Base Ohakea, 01 September 2016).

classification, instructions, and material required to embody the SB.<sup>406</sup> The sheer number of SBs being received by New Zealand presented a challenge in its own right. Unlike other RNZAF fleets, NHI was issuing a significant number SBs to customers each year. With an excess of forty SB received per year, and a total of 680 between 2012 and 2016,<sup>407</sup> this placed a heavy burden on resources and the manpower requirements to manage the volume of SBs, plus source the material needed, which was in itself problematic as spare parts to satisfy the SBs were scarce.<sup>408</sup>

SBs issued by NHI, are classified into four categories. The categories are determined by the nature of the instruction being provided. Category One SBs are described as *Emergency Mandatory SB Cat 1*, which relate to an incident classified as major and unsafe. The embodiment of this SB usually takes place immediately, and NHI covers the cost. Category Two SB are described as *Mandatory SB Cat 2*, and like in Cat 1 SBs, the cost is covered by NHI but the mandatory implementation of the SB can occur within hours rather than immediately.<sup>409</sup> Category three is *Recommended SB Cat 3* and does not directly impact airworthiness, whereas the Category Four *Optional SBs Cat 4* are optional and refer to engineering change; both of these latter categories are at the customers cost and responsibility to source material required to carry out the instructions.<sup>410</sup> A fundamental flaw in the NHI SB process quickly became apparent. NHI customers found that while the engineering functions of NHI would release the SB, NHI's own internal supply chain was unable to satisfy the material required to carry out the activity. This led to pressures on the ability of the RNZAF supply chain and maintenance units to maintain aircraft serviceability and availability.<sup>411</sup> Due to the management overhead, volume and the costs involved from the SB being received, the RNZAF established a SB steering group at Ohakea, which comprise of NH90 FST (Technical

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<sup>406</sup> G, 2017; F, 2017; E, 2017.

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<sup>408</sup> Participant F, Clarification of Interview Information. Email, 26 February 2018.

<sup>409</sup> Ibid.

<sup>410</sup> Ibid.

<sup>411</sup> "Royal New Zealand Air Force."

and Supply) personnel. The purpose of the steering group was to monitor and manage the SBs, prioritise when and if the SB would be embodied on the aircraft, the resources required, and the status of SB activity. This placed an unexpected and heavy burden on the NH90 FST as significant effort was required to obtain the material and manage the SB requirements, alongside pre-scheduled maintenance, operational tempo, and Squadron tasking.<sup>412</sup>

Unlike the NH90 that was early in the production phase of the Product Life Cycle, the Seasprite was at the mature end of the cycle. The NH90 was still being manufactured on multiple production lines across Europe and Australia,<sup>413</sup> whereas the Seasprite was no longer being produced. Age, old technology, small global fleet and obsolete systems make the Seasprite challenging to sustain. When the New Zealand Government purchased the Super Seasprites, the aircraft was already carried with it significant obsolescence risk plus the threat of future obsolescence issues.<sup>414</sup> In 2014, New Zealand was buying 1985 technology with a very limited global presence. The business case and White Paper identified obsolescence risk along with a number of strategies to mitigate through upgrades to the full-mission-flight-simulator and software development environment. These initiatives were funded by the MHCP in addition to the purchase of two non-flying aircraft and a spares package from Kaman Aerospace.<sup>415</sup> Subsequent to the disposal of these aircraft by the Australian Government, spares not included in the disposal, and common to their S70 B Seahawk helicopter fleet, were retained for RAN use. New Zealand however expressed an interest in obtaining these spares when Australia retired and disposed of the Seahawk capability, as a source of spares, and method of mitigating some known obsolescence issues on acquisition.<sup>416</sup> The Seasprite continues to experience obsolescence issues particularly with some systems specific to the Seasprite 'I' variant, which are no

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<sup>412</sup> G, 2017; F, 2017.

<sup>413</sup> "NH Industries - The Company," NH Industries, [http://www.nhindustries.com/website/en/ref/The-Company\\_150.html](http://www.nhindustries.com/website/en/ref/The-Company_150.html) (accessed 11 March 2018).

<sup>414</sup> B, 2017.; D, 2017.; G, 2017.; C, 2017.

<sup>415</sup> "Major Projects Report 2016," 109, 97.

<sup>416</sup> Ibid., 41; D, 2017.

longer in production. This makes it very difficult to sustain the aircraft and creates significant drain on manpower as the supply chain continually scours the market and leverages existing relationships to maintain aircraft serviceability.<sup>417</sup>

## **Relationships**

Defence have experienced both positive and challenging relationships with stakeholders in the sustainment of the NH90 and Seasprite helicopters. The NZDF is disadvantaged by geographic distance from both Kaman Aerospace in the US, and NHI representatives in France. Isolation and differences in culture puts the NZDF in a different time zone and adds risk to already lengthy sustainment lead and turn-around cycle times.<sup>418</sup> Added to this, while both organisations transact in English, there is cultural and language differences, which present subtle but important differences in the way business is conducted. Sustaining military aircraft through the US is hampered by strict government legislation such as the International Traffic and Arms regulations (ITAR) and other export controls.<sup>419</sup>

Typically the 'US' style of doing business is geared up for large-scale US military contracts, rather than a programme that is generally no longer supported by US Department of Defense. In the case the Seasprite, US sustainment is now predominantly accessed by 'small fleet' nations such as New Zealand. This creates difficulties for small nations who don't have the same leverage or buying power to shape business relationships, and there is no current access to a Seasprite user community due to the small number of aircraft being operated globally.<sup>420</sup> The NZDF have already been engaged with Kaman Aerospace for over 15 years through the operation of previous variants of the Seasprite.<sup>421</sup> During that time, the NZDF have experienced some challenging times working with Kaman Aerospace. While there were natural frustrations with costly repairs and delays in turn round time

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<sup>417</sup> B, 2017; C, 2017; D, 2017.

<sup>418</sup> G, 2017; F, 2017; Wills, "Vendor Performance Management NH90 and A109 Supply Chain," 6, 28, 33.

<sup>419</sup> *The International Traffic in Arms Regulations (ITAR): 22 C.F.R. Chapter 1, Subchapter M Parts 120-130* 2.

<sup>420</sup> C, 2017; D, 2017.

<sup>421</sup> "Major Projects Report 2016," 199.

to return assets to serviceability, the primary problem was NZDF's lack of ability to influence the relationship to improve Kaman Aerospace's commitment in sustainment efforts required to support the NZDF Seasprite capability.<sup>422</sup> This was not entirely Kaman's doing, the NZDF also had a part to play in this situation as there had been a misalignment in expectations and collaborative direction between the NZDF and Kaman Aerospace. When it was announced that the New Zealand Government was purchasing the Super Seasprite from Kaman, based on previous experiences and relationships, the sustainment organisations pondered what the future might hold in sustaining and supporting Kaman aircraft. However high-level efforts by the New Zealand Defence agencies, along with the MHCP, RNZAF, and wider NZDF commercial and logistics organisations, have sought to improve and strengthen relations between Kaman and the NZDF, thereby fostering increased incentive for Kaman's commitment to the New Zealand Seasprite programme.<sup>423</sup>

Relationships with vendors supporting NH90 are different case altogether and present their own unique set of circumstances. As the NH90 programme was introduced into New Zealand it became quickly evident that the 'Kiwi' way was not well understood by the NHI organisation. Equally, New Zealand's assumption on how to interact with European nationals with a first language that was not English was problematic. Doing business with NHI in the European markets meant face-to-face engagement was needed.<sup>424</sup> This required constant facilitation with other user nations and NHI in the same room, to influence improvements in performance and delivery of ILS and capability.<sup>425</sup> As part of the NH90 project, an onsite Logistics Field Representative (LFR) was embedded within the RNZAF supply chain and co-located with RNZAF personnel.<sup>426</sup> The NH90 also had a strong user community, which transacted through NAHEMA.<sup>427</sup> Member nations, which New

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<sup>422</sup> C, 2017; D, 2017.

<sup>423</sup> B, 2017; C, 2017; D, 2017.

<sup>424</sup> "Vendor Performance Management NH90 and A109 Supply Chain," 4.

<sup>425</sup> Ibid., 14-15; G, 2017; F, 2017.

<sup>426</sup> "Royal New Zealand Air Force," 21.

<sup>427</sup> "NH90 Programme and JMAAN Organisation," 5.



Zealand has become a part of, are afforded an opportunity influence the shape of future NH90 priorities and initiatives alongside other user nations. As time goes on, NHI is looking to further increase TLS engagement with user nations through NAHEMA.<sup>428</sup>

The NZDF has been fortunate to maintain a direct relationship with NHI. The NZDF established direct TLS arrangements with NHI commencing when the NH90 helicopters were Introduced-Into-Service.<sup>429</sup> As the services of the LFR came to end, the RNZAF had built sufficient corporate knowledge and relations with NHI, and the user community to allow the NH90 supply chain to stand on its own two feet. However FST personnel were travelling to France from New Zealand on a regular basis to maintain direct face-to-face relationships with NHI and the NH90 community. The NZDF recognised the value and opportunity in investing in the establishment of a European Resident Team in the South of France; comprising of a senior Supply Officer and a senior Engineering Officer,<sup>430</sup> this team became the face and manager of the NZDF relationships in France and Europe. This in turn has produced positive effects for the supply chain and wider FST in the sustainment of the NH90.<sup>431</sup> For example, by having NZDF personnel on the ground in France, this enabled greater and quicker access to information and supplier ILS, plus resolving the more complex and long term outstanding sustainment issues, as well as managing the commercial arrangements and NZDF relationship face-to face-with NHI.<sup>432</sup>

Equally, NHI have also taken an interest through the ERT and direct engagement with Maintenance units, in understanding customer expectations of the NZDF, and the process the RNZAF supply chain follows to sustain aircraft.<sup>433</sup> In particular, NHI and other user nations have taken a key interest in the success of the establishment and sustainment of the RNZAF NH90 deeper maintenance

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<sup>428</sup> G, 2017.

<sup>429</sup> "Vendor Performance Management NH90 and A109 Supply Chain," 4-5.

<sup>430</sup> Ibid., 4.

<sup>431</sup> G, 2017.

<sup>432</sup> Elliott.

<sup>433</sup> Wills, "Vendor Performance Management NH90 and A109 Supply Chain," 14, 33.

programme.<sup>434</sup> In earlier years, the NH90 supply chain keenly followed the experience of other NH90 user nations as they paved the way in NH90 sustainment. Users were expressing frustration at the time it was taking to carry out the 600 flight hour maintenance due material availability. In light of other nation's experience, the NH90 supply chain took a pragmatic approach in the absence of maintenance history, by manually analysing material requirements by activity.<sup>435</sup> This provided the supply chain the data required to raise purchase orders with NHI and subsequently facilitated by the ERT, for material requirements well in advance of the first scheduled 600 flight hour maintenance activity. This approach was reliant on the relationships with other NH90 users and NHI, which was critical and continues to be a key success factor in New Zealand's ability to achieve a quick maintenance turnaround in the sustainment of the NH90.<sup>436</sup>

Chapter 3 examined the findings that emerged from primary research carried out with senior NZDF personnel. The grouping of findings into six key areas has identified the significant impacts of the acquisition and introduction of the NH90 and Seasprite helicopters. Importantly these findings have illustrated that despite the product maturity of each helicopter, or whether the manufacturers are based in the USA or Europe, similar challenges have emerged. The findings suggest that relationships are key in the sustainment of air power capability, however the sustainment units, and in particular the RNZAF supply chain is significantly hampered by resource constraints, corporate knowledge and posting cycle issues, as well as a lack of investment by Defence in ILS across all stages of the Capability Life Cycle. In the next chapter, a SWOT analysis has been conducted to critically analyse the effects the emergence of these six key findings have had on the RNZAF supply chain.

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<sup>434</sup> E, 2017; G, 2017; Elliott, Elliott, 1.

<sup>435</sup> E, 2017.

<sup>436</sup> F, 2017; G, 2017.

## Chapter 4 – SWOT Analysis of Research Findings

“Checking the results of a decision against its expectations shows executives what their strengths are, where they need to improve, and where they lack knowledge or information”.

Peter Drucker<sup>437</sup>

The RNZAF supply chain is an intricate set of functions that link together to provide logistic support to air capability in the generation NZDF outputs. The reason the supply chain exists is to enable the RNZAF to maintain the serviceability of aircraft and enable the availability of air and naval helicopter capability to meet New Zealand Government tasking. As discussed in Chapter 2, the supply chain has out of necessity been structured to sustain aging RNZAF aircraft, such as the Iroquois (now retired), C130LEP and P-3K2, which have been in service for over forty years.<sup>438</sup> With the introduction of the NH90 and Seasprite helicopter fleets, the findings outlined in Chapter 3 have impacted the RNZAF supply chain in a number of ways. Importantly, there is a fundamental need to understand flow on effects on the RNZAF supply chain. When pondering, planning and establishing sustainment concepts, acquisition projects should be considering the potential desirable and undesirable consequences beyond the scope of the project when making strategic decisions regarding sustainment.<sup>439</sup>

When developing strategy to sustain military capability, projects also need to understand the first, second and third order effects of organisational policy and

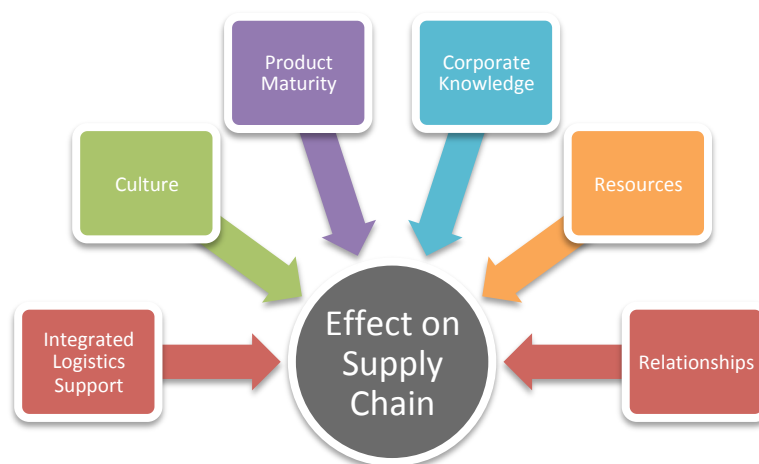
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<sup>437</sup> Peter F. Drucker, *The Effective Executive* (New York: HarperCollins, 2006). xvii; "What Makes an Effective Executive," *Harvard Business Review*, no. June (2004).

<sup>438</sup> "Integrated Logistics Support in Capability Management Handbook," 5.

<sup>439</sup> Michael G. Miller, "Thinking About Second & Third Order Effects: A Sample (And Simple) Methodology," *IOSPHERE Joint Information Operations Centre* vol. Summer 2006, no. Summer 2006 (2006): 39.

culture. Entities such as the NZDF should be developing coping strategies for when those consequences are realised. Second and third order effects occur when an initial set of actions trigger cause an effect at a secondary and tertiary level. While organisations cannot always predict cause and effect outcomes with 100% accuracy, experts describe the central need to understand what second and third order of effects may occur within that “inter-related complex system” and consider how each of the “elements will interact”.<sup>440</sup> This concept is one of the foundation building blocks to developing ILS concepts and making TLS decisions. Considerations when developing sustainment concepts and plans, should include detail on how military aircraft will be sustained throughout their capability life cycle to meet their intended operational requirements.<sup>441</sup> The earlier this concept is embraced the greater the ability for stakeholders and industry to identify and comprehend the second and third level of effect in the sustainment of capability. Six principle findings emerged from primary research interviews conducted as part of this study with senior NZDF personnel with experience of the NH90 and Seasprite programmes. These areas are important because the underlying causes have had an effect on the RNZAF supply chain. Figure 9 below illustrates the six key findings, which comprise Resources, Corporate Knowledge and Culture, Integrated Logistics Support, Product Maturity and Relationships.



**Figure 9 Key Findings**

<sup>440</sup> Ibid., 36.

<sup>441</sup> Jones, *Integrated Logistic Support Handbook*: 23.1; H, 2017.

For this thesis, a SWOT analysis has been conducted to be able to better understand and demonstrate the effects. SWOT analysis is used as a method of describing organisational performance factors within internal and external operating conditions. The performance is broken into four quadrants: internal 'Strengths' that typically include enablers to increase organisational performance goals; internal 'Weaknesses' that identify constraints on desired performance; 'Opportunities', which are the external enablers to organisational performance; and, conversely, 'Threats', which are external constraints to performance goals.<sup>442</sup> SWOT analysis is a simplified process, which is a rewarding exercise in an academic study as it allows the researcher to present qualitative data about an organisations performance in a structured way. SWOT has been applied to findings collected from interviews with NZDF personnel, distilled into core themes and then presented in this thesis in a meaningful way.<sup>443</sup>

When carrying out the SWOT analysis, the first, second and third order of effects on the RNZAF supply chain, has been broken down by quadrants in Table 1 below. In some cases, the findings related to multiple quadrants dependant on the underlying cause or aircraft platform. Furthermore, often where there were Weaknesses or Threats, this created potential options for these to be converted into Strengths and Opportunities. In the case of effects relating to Culture, they were often intrinsically intertwined with other key findings and therefore are highlighted in each quadrant of the SWOT analysis.

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<sup>442</sup> Leigh, "SWOT Analysis," 1090.

<sup>443</sup> Helms and Nixon, "Exploring SWOT Analysis - Where Are We Now?: A Review of Academic Research from the Last Decade," 216, 29; Leigh, "SWOT Analysis," 1050.

Internal		External	
S Strength	W Weakness	O Opportunity	T Threat
<b>Relationships</b> <ul style="list-style-type: none"> <li>✓ RNZAF FST</li> <li>✓ NH90 ERT</li> </ul>	<b>Relationships</b> <ul style="list-style-type: none"> <li>✓ NZDF matrix</li> </ul>	<b>Relationships</b> <ul style="list-style-type: none"> <li>✓ Strengthen NH90 community networks</li> <li>✓ Continue strengthening NHI relationship</li> <li>✓ Foster a Seasprite community</li> <li>✓ Strengthen Kaman relationship</li> </ul>	<b>Relationships</b> <ul style="list-style-type: none"> <li>✓ No Seasprite community</li> <li>✓ Kaman historic relationship tenuous at times</li> <li>✓ Small global Seasprite fleet</li> <li>✓ NZDF fleet of NH90 is small on global scale</li> <li>✓ Distance between NZ and OEMs</li> </ul>
<b>Resources</b> <ul style="list-style-type: none"> <li>✓ Blended workforce supporting NH90 DLM</li> <li>✓ NH90 ERT</li> </ul>	<b>Resources</b> <ul style="list-style-type: none"> <li>✓ Funding, Personnel</li> <li>✓ Investment in knowledge</li> <li>✓ Reporting</li> <li>✓ Insufficient access to or investment in spares</li> </ul>	<b>Resources</b> <ul style="list-style-type: none"> <li>✓ Explore options for NH90 common sustainment initiatives</li> <li>✓ Implementation of EMARs - options for interoperability and multi-nation spares pools</li> </ul>	<b>Resources</b> <ul style="list-style-type: none"> <li>✓ Insufficient spares or investment by OEMs insustainability initiatives to meet In-Service demand</li> </ul>
<b>Corporate Knowledge</b> <ul style="list-style-type: none"> <li>✓ Knowledge of the previous SH-2G(NZ)</li> </ul>	<b>Corporate Knowledge</b> <ul style="list-style-type: none"> <li>✓ Knowledge of the NH90 &amp; I specific aspects of the SH-2G(I)</li> </ul>	<b>Corporate Knowledge</b> <ul style="list-style-type: none"> <li>✓ NHI knowledge of the NZDF</li> </ul>	<b>Corporate Knowledge</b> <ul style="list-style-type: none"> <li>✓ NHI limited knowledge of the RNZAF operating, sustaining and support</li> </ul>

			aircraft
<b>Integrated Logistic Support</b> <ul style="list-style-type: none"> <li>✓ Developing MyNH90 ILS Spares and MRO portal with NHI</li> </ul>	<b>Integrated Logistic Support</b> <ul style="list-style-type: none"> <li>✓ Expertise</li> <li>✓ Ownership and acceptance</li> <li>✓ Investment In-Service phase and wider Capability Life Cycle</li> </ul>	<b>Integrated Logistic Support</b> <ul style="list-style-type: none"> <li>✓ Advocating and continue advancing MyNH90 portal</li> </ul>	<b>Integrated Logistic Support</b> <ul style="list-style-type: none"> <li>✓ Kaman investment in ILS to support obsolescence and sustainment issues</li> <li>✓ NHI progress in developing timely ILS sustainment initiatives</li> </ul>
<b>Product Maturity</b> <ul style="list-style-type: none"> <li>✓ Influence through NH90 User community</li> </ul>	<b>Product Maturity</b> <ul style="list-style-type: none"> <li>✓ Managing NH90 service bulletins</li> <li>✓ Timely access to material, spares and MRO support</li> <li>✓ Obsolescence</li> </ul>	<b>Product Maturity</b> <ul style="list-style-type: none"> <li>✓ Influence through NH90 User community</li> </ul>	<b>Product Maturity</b> <ul style="list-style-type: none"> <li>✓ Immature NH90 and early obsolescence</li> <li>✓ NH90 Service Bulletins</li> <li>✓ SH-2G(I) obsolescence</li> </ul>
<b>Culture</b> <ul style="list-style-type: none"> <li>✓ ERT in France immersed French culture</li> </ul>	<b>Culture</b> <ul style="list-style-type: none"> <li>✓ Human factors</li> <li>✓ "Do More With Less"</li> <li>✓ Posting cycle</li> <li>✓ Organisation under pressure</li> </ul>	<b>Culture</b> <ul style="list-style-type: none"> <li>✓ Working with NZDF through NH90 User and ERT</li> <li>✓ Formation of SH-2G(I) user group</li> </ul>	<b>Culture</b> <ul style="list-style-type: none"> <li>✓ French OEM</li> <li>✓ American OEM</li> <li>✓ Government export control compliance</li> </ul>

Table 1 SWOT Analysis –NH90 and Seasprite supply chains

## Strengths (S)

The data accumulated in this thesis showed that there were many challenges to overcome, but there were also a number of strengths that emerged from the

supply chain. These strengths included strong Defence relationships at the coalface. Typically these were *ad hoc* and personality based,<sup>444</sup> such as the positive level of communication that was occurring within both the NH90 and Seasprite FSTs. While not perfect, the FST had brought the supply and engineering expertise closer together, albeit not in a particularly structured way. With common goals in the sustainment of capability, participants found that just by being in the same vicinity, and involved in conversations going around on around them, they were able to either input into the situation directly or were provided with an opportunity to educate others in pertinent contextual background.<sup>445</sup> The strategic levels of the organisation continued to struggle with a historic culture of friction and independence discussed in Chapter 2, however personnel involved at the lower levels such as the FSTs are engaging with each other in a meaningful and valuable way. It follows then that because of this level of communication within the FSTs, supply chain or technical support areas were able to make more informed and effective decisions concerning capability sustainment.

Having an in-depth corporate knowledge of the previous variant of the Seasprite provided some advantages to the RNZAF in the support of the Seasprite capability. The RNZN operated the 'NZ' variant for 15 years; these aircraft were sustained by the RNZAF.<sup>446</sup> It was recognised that the MHCP would have the advantage of the NZDF already having corporate knowledge in the operations of the Seasprite helicopter, and that only the 'I' specific areas of knowledge would need to be developed. Those participants who were experienced or involved in the sustainment of the Seasprite acknowledged this was a definite advantage.<sup>447</sup> However, while the supply chain had the knowledge of the previous variant, this did not make it any easier to sustain systems common to both the 'NZ' and 'I' variants.<sup>448</sup> From past experience, the supply chain the Seasprite would be difficult to support because it was old technology and such a small fleet operating globally.

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<sup>444</sup> B, 2017; C, 2017; D, 2017; E, 2017; F, 2017; G, 2017.

<sup>445</sup> C, 2017; F, 2017; G, 2017.

<sup>446</sup> "Naval Helicopter Replacement".

<sup>447</sup> C, 2017; D, 2017.

<sup>448</sup> C, 2017.



Conversely, the depth of existing NZDF corporate knowledge operating the Seasprite, would also become a weakness. The NZDF underestimated the knowledge required around the complexity and difficulties in sustaining the new systems that were introduced with and specific to the 'I' variant.<sup>449</sup> For example, the NZDF had never previously operated with an ITAS, whereas the Australian review into their Super Seasprites,<sup>450</sup> had specifically pointed out the ITAS was a particularly complex and flight critical area to the helicopter operations. This makes it more complicated for, and a drain on inexperienced manpower within supply chain to sustain, while also getting to grips with the associated export control complexities attached to the 'I' variant.

Strengths also emerged from efforts by the RNZAF's approach to the NH90 deeper level maintenance programme. For example, the use of blended work force<sup>451</sup> discussed in Chapter 3 to ensure sufficient corporate knowledge was onsite to carry out the task. Equally, efforts by the supply chain to pre-order spares in advance to mitigate known lead-time and availability issues ensured material was available where possible before the maintenance activity commenced.<sup>452</sup> Additionally, the NZDF recognised the value and opportunity of investing in the establishment of an ERT in France (discussed in Chapter 3). This has meant that where there are sustainment issues relating to the NH90 maintenance programme or other issues requiring facilitation, the ERT can address quickly the problem at hand, face to face and in the same time zone. For example, the strength of the relationship really came to the fore when the NH90s were part of the NZDF response providing disaster relief to Fiji in February 2016 after cyclone Winston<sup>453</sup>, and again closer to home in New Zealand after the Kaikoura

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<sup>449</sup> Ibid; D, 2017.

<sup>450</sup> Little et al., "The Super Seasprite," 19-20, 74.

<sup>451</sup> E, 2017.

<sup>452</sup> F, 2017; G, 2017.

<sup>453</sup> "NH90 Helicopters Prove Their Worth in Fiji," New Zealand Defence Force, <http://www.nzdf.mil.nz/news/media-releases/2016/20160404-nhptwif.htm> (accessed 30 March, 2018).

Earthquake in November 2016.<sup>454</sup> Where requests for sustainment assistance were received from the NH90 supply chain through the ERT, NHI ensured solutions were provided as soon possible to meet the urgent need. The Fiji and Kaikoura examples along with the communication between the FSTs, and the corporate knowledge of the previous Seasprite variant held by the RNZAF, demonstrate important strengths that the RNZAF supply chain has been able to draw on in support of the NH90 and Seasprite helicopter capability In-Service.

### **Weakness (W)**

A great many weaknesses were observable in the NH90 and Seasprite supply chains. This was particularly prevalent in the depth of corporate knowledge. For example, a lack of corporate knowledge of the NH90 capability has affected a variety of areas.<sup>455</sup> Unlike the Seasprite that were much older at the time of entering into contract, the NH90 was new which meant the NZDF was reliant on the information provided by NH Industries (NHI). Other user nations were experiencing significant delivery delays at the time, or had only just started operating their own aircraft, so there was comparatively little data to be gleaned. With no organic history pertinent to the New Zealand variant of the NH90, or other nations with the same NH90 configuration or fleet size, the supply chain could not draw on data when making sustainment decisions. A common sense approach to making supply chain decisions was used based on basic supply chain data being collected at the time, and what limited knowledge could be gleaned from the experience of other nations.<sup>456</sup> The resources were not available at the beginning of the In-Service phase to develop a robust supply chain reporting framework.

The supply chain attempted to put basic reporting around critical NH90 sustainment failure points.<sup>457</sup> Outside of the standardised procedures to facilitate supply chain transactions within SAP (discussed in Chapter 3), there was no

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<sup>454</sup> "NZDF NH90s Bring Aid Supplies to Kaikoura," New Zealand Defence Force, <http://www.nzdf.mil.nz/news/media-releases/2016/20161115-nzdf-nh90s-bring-aid-supplies-to-kaikoura.htm> (accessed 30 March, 2018).

<sup>455</sup> B, 2017; C, 2017; D, 2017; E, 2017; F, 2017; G, 2017.

<sup>456</sup> Wills, "Vendor Performance Management NH90 and A109 Supply Chain," 1, 4; G, 2017; F, 2017.

<sup>457</sup> B, 2017; C, 2017; F, 2017; G, 2017.

standardised approach to performance reporting or overarching supply chain management process. This highlighted an important weakness in the fact that each individual supply chain responsible for sustaining capability is more focused on their specific aircraft types, but at a supply chain management level divergence in process has occurred across the RNZAF supply chain because there is no standardised business rules or methodology.<sup>458</sup> For example, the NH90 supply chain kicked off an early evolution of supply chain reporting, however this was reliant on a manual process. Over time, the NH90 supply chain recognised the need for data and invested a significant effort into developing formal reporting mechanisms. The framework uses a combination of manual processes, Business Intelligence reporting from SAP, and Excel reporting. This initiative has built a dashboard to provide key performance metrics that drives the sustainment of the NH90 fleet.<sup>459</sup> However, this has not been the case with the Seasprite supply chain, whose personnel recognised the importance of performance reporting but had insufficient resources to get their own robust framework off the ground. In fact, a number of participants in this study recognised there was an opportunity to review the performance reporting development already occurring in the NH90 supply chain, and determine whether there was an opportunity to ‘piggyback’ off the NH90 initiative.<sup>460</sup> The divergence in standardised supply chain management process has transpired primarily because there has been erosion in the depth of generic supply chain, and capability specific corporate knowledge, plus a lack of resourcing.

The absence of capability-specific corporate knowledge is not the only corporate knowledge weakness. At an organisational level, this thesis has also highlighted serious systemic resources constraints along with career management policies that have on-going and significant adverse effect on the depth and growth of supply chain corporate knowledge as whole. This includes the RNZAF 2-3 year military posting cycle (see chapter 3 for discussion). The enduring effect this has had on the

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<sup>458</sup> B, 2017; C, 2017; F, 2017; G, 2017.

<sup>459</sup> F, 2017.

<sup>460</sup> B, 2017; C, 2017; F, 2017.

supply chain was revealed by multiple expressions of frustration by participants in this study regarding this topic. Based on primary research interviews, evidence suggests that the supply chain establishments are not set at the right levels for the specific capability they support. The establishments have not allowed for the complexity of the effort expended to address sustainment challenges, and still meet sustainment expectations. For example, when the Seasprite replaced the 'NZ' variant, the additional capability, complexity and obsolescence issues introduced, did not equate to an increase in personnel numbers for the supply chain to handle the increased complex workload.<sup>461</sup>

Added to this, is the constant churn of personnel along with the Service's 'doing more with less' philosophy. This has meant there are continuing vacancies, an increase in throughput requirements and steep learning curves for personnel posted into the RNZAF supply chain.<sup>462</sup> As result, erosion occurs in both generic and capability supply chain knowledge and experience. This is evident in both the NH90 and Seasprite supply chains. The effect of this has meant the supply chain is constantly trying to regenerate lost knowledge in personnel, only to have the cycle repeat again as personnel are posted out.<sup>463</sup> The next level effect is the inefficiencies in effort expended by the supply chain to maintain productive personnel. For example in recent years, the NZDF has pushed to civilianise certain roles in sustainment areas to free up uniformed personnel for frontline operations.<sup>464</sup> This, however, has created another layer of issues, such as there may not be the required expertise in the market, or the roles not enticing enough to attract those that have the right skill set and experience.<sup>465</sup> Therefore, longevity

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<sup>461</sup> B, 2017; C, 2017.

<sup>462</sup> C, 2017; F, 2017; G, 2017.

<sup>463</sup> C, 2017; F, 2017; G, 2017.

<sup>464</sup> "New Zealand Defence Force: The Civilianisation Project," (Wellington: Office of the Auditor-General, 2013), 4; "Minister Disputes Critical Report on Defence Restructure," Radio New Zealand, <http://www.radionz.co.nz/news/national/126854/minister-disputes-critical-report-on-defence-restructure> (accessed 07 March, 2018).

<sup>465</sup> "New Zealand Defence Force: Progress With the Defence Sustainability Initiative," 17.

and continuity of civilian personnel in the supply chain remains a problem in tandem with the military posting culture.<sup>466</sup>

Resource constraints are not limited to personnel and corporate knowledge challenges in sustainment. Insufficient whole-of-life funding of capability and sustainment activity has become a key issue inside the In-Service phase of both the NH90 and Seasprite capability life cycles. Complex modern NH90s and mature Seasprite helicopters capabilities are expensive to sustain.<sup>467</sup> With insufficient spares purchased in the original acquisition of the NH90 fleet to compensate for lengthy lead times and unanticipated comprehensive major deeper level maintenance programmes, unintended and expensive consequences have occurred. The on-going NH90 deeper maintenance including the impending 1200 flight hour maintenance requires additional rotatable components and line replacement units (LRU) discussed in Chapter 3.<sup>468</sup> Equally, the Seasprite supply chain finds itself in a similar situation where there was an estimated increase in the annual sustainment cost of support 'I' capability, however there been little increase in funding which has meant the supply chain has been expected to fund from existing budget lines.<sup>469</sup>

With a shift in culture along with pressures from fiscal constraints that focused on cost savings, this led to distractions and pressure as the organisation was undergoing significant change.<sup>470</sup> In 2015, the State Services Commission carried out a performance review of the NZDF that raised concerns over Defence's ability successfully implement and embed change. NZDF Chief of Defence Force Lieutenant General Timothy Keating acknowledged the issue was a known problem; in his response to the report he stated, "We do not have a consistent track record of implementing and embedding change and that we often struggle to realise the benefits expected from the changes we set out to make." He pointed out

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<sup>466</sup> C, 2017; D, 2017; H, 2017.

<sup>467</sup> E, 2017; F, 2017; G, 2017.

<sup>468</sup> B, 2017; C, 2017; D, 2017; G, 2017.

<sup>469</sup> E, 2017; F, 2017; G, 2017; H, 2017.

<sup>470</sup> Haddon-Cave, "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," 355-56.

that the senior leadership must make sure that “all our people are able to embed the culture and behaviours which help us improve our implementation of change and lift our performance to the next level”<sup>471</sup>. Reviewers in 2015 pointed out that there was a significant level of investment in new military platforms, which required investment growth of people to ensure full capability benefits were realised. However it was also noted in the review that “addressing posting turbulence” would be critical to success.<sup>472</sup> In 2017 this was again highlighted as part of a brief to the incoming Defence Minister, which said “Defence must ensure sufficient personnel for current operations as well as growing the people required to transition and use new future capabilities”.<sup>473</sup> Primary research interviews suggest that despite the introduction of the NH90 and Seasprite, during and after the Performance Framework Review of the NZDF (2015), posting and a general lack of personnel remains a significant issue in sustainment units. Furthermore, those units, including the supply chain have little capacity at the time of writing to undertake additional initiatives at the coalface outside of the day-to-day sustainment of aircraft.<sup>474</sup>

Like with the budgets of many Government ministries, Defence’s budget is tight and constrained due to government and political pressures. With the implications of the supply chain funding issues having the potential to affect the wider NZDF, there is a growing concern from participants that there are simply insufficient resources to address the problems.<sup>475</sup> As a result, the flow-on effect puts the supply chain under increasing, and arguably, unreasonable sustained pressure and expectations. The next level of effect is the creation of human factor issues with significant stress being placed on supply chain personnel<sup>476</sup> Resilience of

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<sup>471</sup> "Performance Improvement Framework: Review of the New Zealand Defence Force (NZDF) September 2015," 5-6.

<sup>472</sup> Ibid.

<sup>473</sup> "Introducing Defence: A Briefing for the Incoming Minister," 42.

<sup>474</sup> B, 2017; C, 2017; D, 2017; F, 2017; G, 2017; H, 2017.

<sup>475</sup> B, 2017; C, 2017; D, 2017; F, 2017; G, 2017; H, 2017.

<sup>476</sup> *Royal New Zealand Air Force Human Performance in Maintenance S00012*, Version 5 RNZAF HPIM 04 November 2016 ed. (Auckland, New Zealand: Aviation Institute School of Engineering, Air New Zealand Limited, 2016). 23-24; "Review of the Implementation of the Court of Inquiry's Recommendations Following the 2010 ANZAC Day Iroquois Crash," 12, 15, 18.

personnel to stressful situations may decrease and therefore effect supply chain performance.<sup>477</sup> This has the increased potential for burnout to occur as personnel are consistently expected to 'do more with less', and juggle multiple priorities and scheduled activities.<sup>478</sup> Funding pressure is occurring year on year, which creates a number of issues such as a constant bow wave effect<sup>479</sup> where activity that must occur to sustain aircraft capability, and which does not make the budget this financial year, is then pushed into the next financial year. However this is also creating more pressure on the next year's sustainment activities months in advance of that year even beginning. Human factor aspects of the supply chain cannot be underestimated.<sup>480</sup> Human factor issues often generate a greater awareness profile through aircraft crash investigations, maintenance philosophy and airworthiness frameworks. However the supply chain is a key link in the RNZAF value chain and therefore undesirable human factors also have the potential to cause undesirable airworthiness effects.<sup>481</sup>

Doctrine provides the foundation principles in the conduct of military organisations, and the sustainment of defence capability. ILS is no exception and is a key component of TLS within the Capability Management Framework (CMF). Doctrine requires ILS to be applied across all stages of the capability life cycle. However within the In-Service stage, the supply chain is neither experienced in ILS doctrine nor the theoretical framework. Additionally there are insufficient resources at an ILS Centre of Expertise level to adequately invest in increasing the ILS footprint requirements within the supply chain.<sup>482</sup> It is unfortunate as this then forces the supply chain into a reactive ILS approach, while they do not really

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<sup>477</sup> "New Zealand Defence Force Everyday Resilience: A Practical Guide to Increasing Performance," ed. NZDF Psychology and NZDF Health (Wellington: New Zealand Defence Force), 1, 11, 13.

<sup>478</sup> "Quarterly Trend Report," (Wellington: New Zealand Defence Force, 2012), 3, 6-7, 10.

<sup>479</sup> "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," 371, 405.

<sup>480</sup> B, 2017; C, 2017.

<sup>481</sup> "Review of the Implementation of the Court of Inquiry's Recommendations Following the 2010 ANZAC Day Iroquois Crash," 15, 18, 29, 32; "The Nimrod Review: An Independent Review into the Broader Issues Surrounding the Loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006," 342, 71, 462, 66; Holmes, "Key Lessons From The Nimrod Review Report: A Failure of Leadership, Culture and Priorities," 9, 15-18, 22.

<sup>482</sup> B, 2017; C, 2017.

understand the depth of the ILS concepts or what ILS should look like during the In-Service phase, or how to apply the framework to their day-to-day sustainment activities. While there is attempts to incorporate ILS early in the Acquisition phase, culturally it appears that the NZDF does not seem to have an appetite to really invest the resources required to make this happen, which results in less opportunity to realise sustainment benefits through life.<sup>483</sup>

During the Introduction-Into-Service stage, DPEC too are mandated to establish or facilitate ILS arrangements and then transition them to In-Service within the FSTs. The problem that occurs with this is due to the matrix style organisation and the management of ILS elements crossing over multiple functional areas, where does the authority and accountability for ILS sit In-Service? Currently there is no one NZDF-wide policy or authority on which Command Chain accepts the formal accountability and responsibility of ILS arrangements as they are transitioned by projects to the In-Service stage of the capability life cycle. There is no one Command Chain that is either mandated, or resourced to take on this role in its entirety, hence the management of ILS is not effectively carried out In-Service.<sup>484</sup> This thesis suggests there are a number weaknesses identified that would benefit from further study. In particular the importance of addressing undesirable human factors emerging from the RNZAF supply chain, the constant resource constraints, the lack investment in ILS In-Service, and how to manage and improve the on-going cycle of losing and re-generating corporate knowledge.

## **Opportunity (O)**

There are a number of external opportunities that exist for the RNZAF supply chain, and wider NZDF organisation. Even though New Zealand is a small nation with an even smaller fleet of aircraft,<sup>485</sup> the NZDF makes the most of the opportunities to growth relationships and effect positive influence on capability sustainment. This was evident in the NH90 supply chain where personnel draw on the strong relationships built by the ERT in France to support the NH90 back in

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<sup>483</sup> H, 2017.

<sup>484</sup> B, 2017; C, 2017; G, 2017; H, 2017.

<sup>485</sup> B, 2017; D, 2017; H, 2017.



New Zealand. Maximising further on-going opportunities to shape the My NH90 portal discussed in Chapter 3, will bode well for the NH90 supply chain, which NHI consider as a key stakeholder in the development process. The development of MyNH90 reporting tools, export and search functions have and will continue to provide the supply chain with valuable insight to further refine and strengthen sustainment activity. Although currently there is a tedious process of duplicating spares ordering i.e. having to create a purchase order in the NZDF SAP information system, and then re-enter it into the MyNH90 portal, there is an opportunity in the pipeline to develop an electronic interface between SAP and MyNH90 eliminating the duplication of effort.<sup>486</sup>

At times the NH90 supply chain also had to overcome difficulties in engaging with a French organisation. While NHI transacts business in English, the 'French' factor has not been underestimated. With the establishment of the ERT, and through hard work with a strong relationship focus, trial and error, and building respect and common understanding between NHI and the RNZAF, significant efforts to create opportunities continued explored to further remove the divide between New Zealand and French culture.<sup>487</sup> This opportunity currently exists through the success of the NH90 deeper level maintenance programme, which has specifically piqued the interest of NHI and many other user nations. NHI sees the RNZAF as a flagship nation due to the New Zealand successes in maintenance activities, which has created one of the highest percentage rates of aircraft serviceability across all NH90 user nations.<sup>488</sup> A number of NHI personnel and other NH90 users have made the trip to New Zealand especially to understand how the NH90 is sustained, along with observing how the RNZAF NH90 deeper level maintenance programme is carried out (discussed in Chapter 3).<sup>489</sup> Primary research interviews supported by industry presentations, highlight this has primarily occurred through the 600 flight hour deeper maintenance level effort, which has returned NH90 aircraft back

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<sup>486</sup> F, 2017.

<sup>487</sup> Wills, "Vendor Performance Management NH90 and A109 Supply Chain," 14, 33.

<sup>488</sup> E, 2017; G, 2017; Elliott, Elliott, 1.

<sup>489</sup> E, 2017; G, 2017; 1.

to service in a shorter time than most other nations.<sup>490</sup> There are a number of opportunities that this thesis has analysed based on the findings that emerged from the primary research interviews. Key opportunities include growth in OEM relationships through the ERT and other mechanisms, plus the on-going partnering with NHI on the development of the MyNH90 ILS portal, and the opportunity to exemplify the success of the NH90 deeper maintenance program.

## **Threats (T)**

The NH90 helicopter platform is an immature aircraft that is still going through refinement or improvements in its design, as it progresses towards standardisation and maturity in the Product Life Cycle. Multiple user nation reports have shown there have been design frustrations, which have been resolved through various compensations over time (discussed in Chapter 1 and 3). Equally the RNZAF receive a large volume of Service Bulletins (SB) requiring implementation across the NH90 fleet.<sup>491</sup> With the churn in engineering design as well as incremental improvements and upgrades, the immaturity of the NH90 Product Life Cycle has created early obsolescence in a new aircraft capability. Faced with OEM pressures to move with changes in material and design, this creates early obsolescence issues, and challenging sustainment decisions to overcome the problem.<sup>492</sup>

The concept of early obsolescence through incremental upgrades or engineering design changes is a shift in the sustainment paradigm for the RNZAF. The NZDF have a tendency to operate aircraft for forty years or more,<sup>493</sup> so more frequent changes to design and configurations, creates an additional burden on the supply chain to manage the supply support aspects of the process.<sup>494</sup> The supply chain is required to undertake appropriate sustainment decisions to support existing capability until such time as the SB upgrade or design change occurs. They also

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<sup>490</sup> E, 2017; G, 2017; 1.

<sup>491</sup> F, 2017; G, 2017.

<sup>492</sup> Elliott, 1; E, 2017; F, 2017.

<sup>493</sup> "Integrated Logistics Support in Capability Management Handbook," 5.

<sup>494</sup> Farmer, Fritchman, and Farkas, "Supporting the Fleet in the 21st Century: Evolutionary Acquisition and Logistics," 28-30.

have to factor in the difficulty of obtaining costly material from OEMs such as NHI to carry out SBs.<sup>495</sup> Dictated by the OEM who generally retains the IP ownership rights,<sup>496</sup> the RNZAF often have little choice but to follow the OEM's recommendation to embody the SBs. The threat of increased frequency in early obsolescence is something the RNZAF will have to come to terms with as many contemporary aircraft OEMs move towards a direction of frequent incremental spiral upgrades (discussed in Chapter 2).<sup>497</sup> The Seasprite supply chain faces similar challenges as the aircraft progresses towards the end of the Product Life Cycle. Threats occur from the difficulty to source sustainment requirements from a shrinking market, which will continue to create a significant burden for the supply chain and wider FST, as they grapple with supporting the Seasprite until its planned withdrawal date in 2030.<sup>498</sup>

The relationship between Kaman Aerospace and the NZDF has historically been professional, but at times strained.<sup>499</sup> Kaman has been supporting New Zealand Seasprite operations for many years. However prior to purchasing the 'I' variants, the supply chain experienced frustrations and difficulties. This included Kaman's internal ILS mechanisms and the Seasprite supply chain's limited access to external markets being able to support more mature technology, and rapidly advancing obsolescence issues. Increases in cost and long lead times meant that the support arrangements provided little impetus or incentive for Kaman to increase commitment in re-establishing manufacturing lines for scarce spares.<sup>500</sup> While still operating the 'NZ' variant, due to the constraints imposed by obsolescence issues, the NZDF invested in access to intellectual property and the US State Department export control approvals, to allow the RNZAF to take an organic approach to manufacturing OEM proprietary parts. With the purchase of

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<sup>495</sup> E, 2017; F, 2017; G, 2017.

<sup>496</sup> Kumar and Krob, *Managing Product Life Cycle in a Supply Chain*: 16-17.

<sup>497</sup> Farmer, Fritchman, and Farkas, "Supporting the Fleet in the 21st Century: Evolutionary Acquisition and Logistics," 28-30.

<sup>498</sup> C, 2017; D, 2017.

<sup>499</sup> A, 2017; C, 2017; D, 2017.

<sup>500</sup> A, 2017; C, 2017; D, 2017.

the most recent Seasprite helicopter, sustainment of the capability was once again constrained by product maturity.<sup>501</sup>

The NZDF was faced with a discrete and very small pool of global Seasprite users. With no current mechanism for a Seasprite user group to influence future sustainment initiatives, primary research interviews suggested there had been a missed opportunity by Defence to strengthen the extant TLS arrangements at the time of the Acquisition negotiations for the 'I' variant. While faced with external threats from increasing obsolescence risks due to product life cycle maturity, the RNZAF has invested in the opportunity to strengthen and foster a more collaborative relationship with Kaman Aerospace.<sup>502</sup> The focus by the RNZAF was to decrease the obsolescence risks, and increase the FST's ability to better support and sustain the Seasprite capability, while also generating a more positive return on efforts for Kaman.<sup>503</sup> The SWOT analysis has highlighted significant external threats primarily around the product maturity and its subsequent effects on the RNZAF supply chain from aircraft obsolescence. While these threats are outside the direct control of the NZDF, continued efforts to bolster OEM and aircraft user relationships at a strategic and FST level, provides an opportunity to reduce the impact of undesirable effects on capability support and sustainment.<sup>504</sup>

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<sup>501</sup> C, 2017; D, 2017.

<sup>502</sup> B, 2017; C, 2017; D, 2017.

<sup>503</sup> B, 2017; C, 2017; D, 2017.

<sup>504</sup> C, 2017; B, 2017; D, 2017.

## Conclusion

“If you have an important point to make, don’t try to be subtle or clever, use a pile driver. Hit the point once then come back and hit it again and then hit it a third time – give it a tremendous whack”.

Winston Churchill, 1919<sup>505</sup>

This thesis has examined the supply chain in air capability acquisition by the NZDF and demonstrates the emergence of first, second, and third orders of effects, on and within the RNZAF supply chain, from the introduction of the NH90 and Seasprite helicopter capability. To understand the effects, the thesis linked Product Life Cycle theory with the RNZAF supply chain structure. Chapter 1 discussed Vernon’s Product Life Cycle theory, which provided both the academic foundation to this thesis and the essential linkage to the Defence Capability Life Cycle. The chapter also introduced the NH90 and Seasprite case studies with focus on acquisition and introduction into operational service. Chapter 2 examined the RNZAF supply chain structure that supports aircraft capability, including the Defence integrated logistic support framework. Additionally, the paradigm shift in the aerospace industry support and sustainment solutions was highlighted as many OEMs evolve to meet changing customer demand, and protect future revenues. Chapter 3 discussed important issues that emerged from the primary research carried out, particularly interviews with senior personnel in the NZDF. Chapter 4 rounded off the thesis with a SWOT analysis as a means of analysing how the key issues identified from primary research have affected the supply chain.

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<sup>505</sup> Richard M. Langworth, ed. *Churchill’s Wit: The Definitive Collection* (United Kingdom: Ebury Press, 2009), 92.

The NZDF has introduced a significant level of air power capability over the last two decades in particular with the NH90 and Seasprite helicopters. The challenges associated with introducing new aircraft, and the technical advances between the replaced aircraft as well as the product maturity of each helicopter, has had significant implications for the RNZAF supply chain, highlighting internal strengths and weaknesses as well as external opportunities and threats to the supply chain. These implications have emerged primarily because of the complexity and difficulty of supporting each aircraft exposing obsolescence issues, difficulties addressing obsolescence impacts, and gaps in the depth of corporate knowledge required to sustain the capability. Findings from the thesis suggests that the knowledge requirements and difficulty accessing timely supply and maintenance support In-Service were underestimated by Defence when the aircraft were acquired.

Not all of the key findings are uniquely attributable to the introduction of the NH90 and Seasprite fleets. A series of systemic organisational weaknesses are highlighted in this thesis. It is evident that these are impacting the sustainment of NH90 and Seasprite aircraft capability at the RNZAF supply chain level. In particular, the cultural norm of “Doing More with Less” has contributed to increases in funding pressure placed on a stressed supply chain that is required to consistently juggle insufficient resources and justify high priority resource allocation across equally high priority sustainment activity. Defence sustainment initiatives such as Dr Roderick Dean’s “Value for Money” report (2010), which led to civilianisation of certain military positions, along with the effects of current career management policy have exacerbated the situation. They have resulted in an on-going distraction of consistently having to re-grow an already shallow level of corporate knowledge as personnel rotate or leave (military and civilian) units tasked with sustaining aircraft capability.

Equally, resource constraints have also created sustainment and support weakness by curbing investment in and ownership of integrated logistic support, knowledge and expertise during the In-Service stage of the Capability Life Cycle. Even with the establishment of the NZDF ILS Centre of Excellence, resources are spread too thinly to ensure Defence wide cultural acceptance and implementation of

integrated logistic doctrine. Many of the resource challenges faced are second and third level effects of reoccurring themes that arose during previous periods of significant capability procurement. Common high level issues have been pointed out in other scholarly studies, most importantly Greener's work on the decisions behind Defence capability, as well as in the Strategos (1988) and Hunn (2002) reports and the Defence Procurement Review (2009). Together, these have highlighted enduring cultural issues between New Zealand Defence agencies, along with inadequate resourcing of major capability acquisitions. Recent developments by Defence to address historical issues have led to the implementation of the integrated project teams, and the release of a new Capability Management System Lifecycle, both of which prioritise whole of life considerations (including resourcing), and increases formal collaboration across Defence in the acquisition and through-life-support of new aircraft capability.

Enduring challenges faced by the RNZAF supply chain and ensuing effects may create undesirable human factors. This is an important weakness that could lead to larger airworthiness issues. The supply chain is a key enabler of serviceable and available aircraft to meet Government tasking. However, with the persistent drive by the NZDF to do more with less, plus an unhealthy resource culture of widening gaps in adequate resources to effectively and efficiently sustain aircraft capability, this puts supply chain personnel in a position where they face consistent pressure to get the 'job done' without adequate resources. It is evident that from the research interviews conducted for this thesis, that this creates burnout with too few personnel, and those that are situated in the supply chain, are tired potentially leading to unhealthy factors, such as chronic stress and an increased risk of larger undesirable effects on airworthiness. While human factor considerations are formally recognised by the NZDF, these have primarily focused on operating and maintenance organisations. Wider consideration of human factor effects on the RNZAF supply chain and other sustainment units should not be ignored.

While the RNZAF supply chain has experienced many challenges, positive findings have also emerged in Chapter 3 that has highlighted internal strengths and future external opportunities for Defence. The RNZAF has built strong NH90 relationships through the establishment of a France-based support team, which has created and

opportunity for New Zealand to influence and improve the effectiveness of sustainment arrangements and support as well as advocate New Zealand NH90 successes in maintenance and operations. In conjunction with NHI, the RNZAF supply chain has also expended considerable effort shaping the development of the MyNH90 portal, which other nations are now utilising. Drawing on corporate knowledge the previous 'NZ' Seasprite, and considering the 'I' variant unique requirements, the Seasprite supply chain continues to grow their relationships with Kaman Aerospace and other manufacturers as it tackles difficult obsolescence issues. In the future there may be an opportunity to create some form of Seasprite user community with other operators to collaborate with the aircraft OEM on wider Seasprite topics.

This thesis shows that there are positive and challenging effects and that lessons can be learned from the introduction of the NH90 and Seasprite. Long-term effects arising from the introduction of aircraft capability highlights Strengths, Weaknesses, Opportunities and Threats at a RNZAF supply chain level. It is apparent that there is scope, either in a larger academic study or a Defence project, to explore these further so that root causes might be addressed. Further, Defence has already shifted its focus towards the future procurement of other new aircraft capability to replace the aging C130LEP, P-3K2 and B757-200 fleets. Therefore, understanding the effects is vital. Root causes of undesirable effects need to be considered else similar effects are likely to be felt on a larger scale from acquisitions and introduction of major air power capability that will shape the RNZAF, and wider Defence, for many years to come.



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### Thesis Research Methodology

During the period March – August 2017, primary research was gathered from eight interviews carried out with current serving NZDF military and civilian personnel who met the participant criterion. Each interview took between one and two hours and was treated anonymously, carried out face to face in an one on one environment, and was sound recorded. The study required participants with subject matter expertise who were asked a series of questions specific to the project, and also given an opportunity to provide any further information relevant to the study. Subjects covered in the study included:

- ✓ NZDF capability
- ✓ Acquisition and Introduction Into Service
- ✓ NH90 helicopter
- ✓ SH-2G(I) helicopter
- ✓ RNZAF Supply Chain
- ✓ Through Life Support
- ✓ Integrated Logistics Support
- ✓ Stakeholder engagement and relationships
- ✓ Organisational structure and culture
- ✓ Training
- ✓ Resources

Both the Massey University Human Ethics Committee Southern B – 16/41 and the NZDF Organisational Research Unit have approved this research project and subjects covered. Questionnaires were standardised for all interviews and included questions pertaining to:

- ✓ Participants subject matter expertise within the ILS framework and support of the NH90 and or SH-2G(I) helicopters.
- ✓ What if any training each participant had received relating to Supply Chain Management, ILS, Through Life Support, Procurement, Contracting, Reporting and Other Best Practices.

- ✓ Description of the Role/s where their subject matter expertise was gained, and length of time in each of those roles.
- ✓ Participants described:
  - Which platform/s they supported or had knowledge of.
  - Organisational structure and process.
  - RNZAF Supply Chain functions.
  - Reporting
  - Adaption or evolution of the RNZAF Supply Chain with the introduction of either the NH90 or SH2-G(I).
  - Impacts on the RNZAF Supply Chain from the maintenance and technical support activities for each helicopter, and vice versa.
  - Implementation and utilisation of the ILS framework within various phases of the capability life cycle.
- ✓ Participants provided input into the SWOT analysis through:
  - Describing internal supply chain Strengths and Weaknesses.
  - Describing external supply chain Opportunities and Threats.
- ✓ Participants were also given an opportunity to put forward any other information pertinent to the research topic.

### **Thesis Research Limitations**

The researcher acknowledges primary research has been gathered over a short period in time and from a small group of experienced participants, therefore some findings that have emerged may have been addressed by Defence policy and initiatives implemented since the research was collected. However historical acquisitions and secondary research support the trending effects and systemic issues therefore as per the conclusions contained within the thesis, there is scope for either a larger academic study or a Defence project, to explore findings further so that root causes might be addressed.