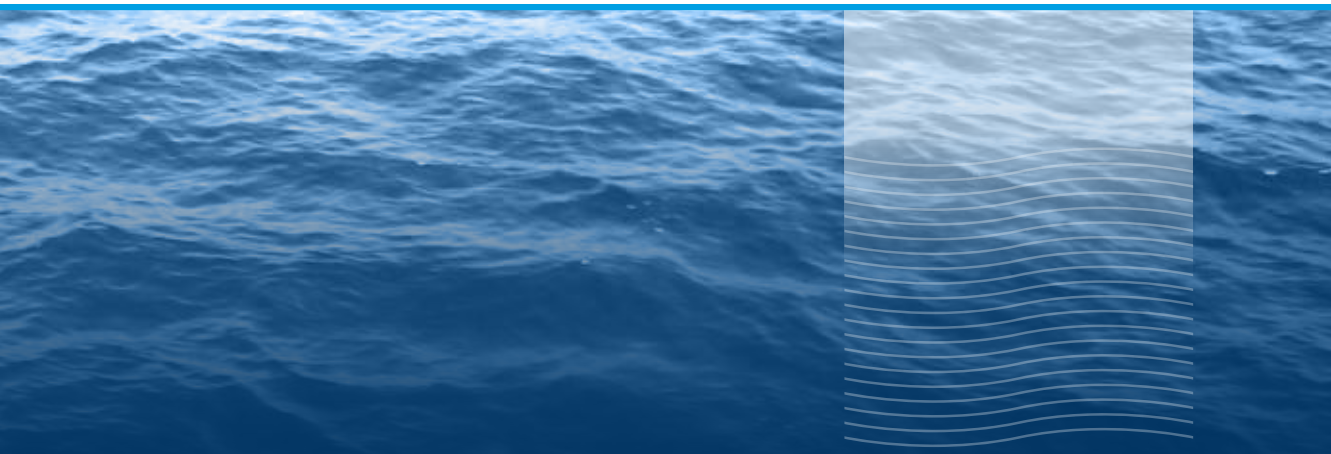





AUSTRALIAN MARITIME DOCTRINE AUSTRALIAN MARITIME LOGISTICS DOCTRINE

1ST EDITION



AUSTRALIAN MARITIME DOCTRINE
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LOGISTICS DOCTRINE
1ST EDITION



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Australian Maritime Logistics Doctrine:

First Edition 2016

Sponsor:

Chief of Navy

Developers:

Jointly developed by Director General Logistics – Navy and Director General Engineering – Navy.

Publisher:

Department of Defence CANBERRA ACT 2600

FOREWORD



The modern Navy is an intrinsic national capability. It is an enterprise which must bring together the private and public sectors of the economy to deliver the national security objective. To achieve this objective, Navy must see itself as a fighting system rather than simply a collection of platforms. When this system is operating in a focused and networked way, it can deliver the decisive lethality required to achieve the government's aims of deterring conflict and contributing to the maintenance of global peace and security.

Lethality is the ability of Navy's fleet to generate decisive outcomes in conflict; and deterrence is a consequence of the ability to deliver strategic lethality, either singularly or in coalition. Lethality can only act as a deterrent if the operational effect generated can be repeated, which means capability must be available and sustainable.

Key to the generation and sustainment of operational effect is ensuring that Navy's strategic purpose, operational concepts and capability requirements are designed into our ships and aircraft. This includes the support system requirements that underpin Navy's sustained capability.

Navy capability must be designed for reliability and supportability; and be complemented by robust support arrangements developed in partnership with Australian industry. Its materiel upkeep must be conducted predictably, reliably, on time and on budget. We must capture and manage knowledge in order to become effective asset managers and improve the readiness and affordability of Navy capability.

Navy will continue to acquire mature designs for its capability. Where we can gain benefit is in looking beyond the build, and designing for sustainment, incorporating such aspects as data recording, real time upkeep management and capability systems update and upgrade evolution. This requires fully integrated and deployable logistics systems that enable effective asset management and optimised whole of life cost across all phases of the capability life cycle.

Navy's logistic support is provided through a complex network of organic capabilities, Defence service providers, industry organisations, and allied Navies through international agreements. As such, there is a need to guide participants in this network on the nature of maritime logistics in capability development and in support to maritime operations.

This is the 1st edition of Australian Maritime Logistics Doctrine (AML). Its purpose is to guide the ongoing development and assurance of maritime support capability. AML amplifies AMD1 – RAN Doctrine and AMD2 – The Navy Contribution to Australian Maritime Operations, by articulating the principles that underpin the design of logistics support systems for new and in-service maritime capability, and the planning and delivery of support to maritime operations. AML is consistent with joint logistics doctrine and emphasises the unique characteristics of maritime support during the realisation and employment of maritime capability.

Defence maritime capability cannot be continuously delivered without robust and effective support. Provision of this support requires all participants within the maritime logistics enterprise to work collaboratively and with commitment to generate and sustain the capabilities necessary to fight and win at sea.

I commend this doctrine to you.



T.W. Barrett, AO, CSC
Vice Admiral, Royal Australian Navy
Chief of Navy
29 February 2016

AUSTRALIAN MARITIME LOGISTICS DOCTRINE

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PREFACE

KEY THEMES

Australian Maritime Logistics Doctrine (AMLDD) complements Navy's operational doctrine described in AMD 1 and 2 by providing Navy's approach to logistics in support of maritime capability, both in achieving preparedness requirements and conducting operations.

Whereas the provision of seaworthy materiel is the primary **output** of maritime logistics, the delivery of repeatable operational effect, as one of the three seaworthiness considerations, is the primary **outcome**. This doctrine focuses on maritime logistics as the enabler that delivers repeatable operational effect from Navy materiel capability.

Chapter 1 – Introduction, provides the context and structure for the whole doctrine, and provides ten principles on which all maritime logistic decisions are based.

The ten principles in the introduction flow through the five chapters to provide an enduring belief system that will assure the delivery of a repeatable operational effect by the materiel components of Navy's ships, submarines, and aircraft.

THE WHAT AND WHY OF DOCTRINE

Military doctrine is the body of thought concerned with the nature, role and conduct of military operations¹. In this document Navy provides its

¹ Australian Defence Force Writing Manual 2013, Chapter 21 Doctrine Writing

body of thought, or 'belief system' as to why and how the maritime logistic enterprise (hereinafter called the 'enterprise') delivers logistic support to Navy's ships, submarines and aircraft² in all phases of their life cycles and in all operational missions in all parts of the globe. This enterprise consists of Navy, Defence and industry elements. The belief system driving maritime logistics is born of the accumulated wealth of knowledge and experience arising from its gestation in the late 16th century Royal Navy, to the birth of the Royal Australian Navy in 1915, until now, another century later, in a high technology age that is still operating in the same challenging environment of the world's oceans.

The writing of doctrine offers a licence to style unlike any other form of Defence written communication. This maritime logistics doctrine is not an instruction, regulation, policy or order. It is simply a set of ten guiding principles. If applied from the top of the organisational hierarchy down to the end user at sea, the principles will assure the effective and efficient delivery of the support products and services required by ships, submarines and aircraft to continuously deliver the required operational effect when and where needed at an optimum through-life cost. The principles are described in plain and simple language aimed at a broad range of readers, some of whom may not be familiar with the maritime environment or the unique logistic demands imposed by it. Use of an expression such as "operational effect" above, while having a special meaning for military readers, is a good example of the best mix of plain language and 'loaded' military language to suit both casual and professional readers. The aim of the logical narrative of this doctrine, however, is intended to be as influential as any Defence regulation or instruction that is informed by it. The principles are an enduring reference set of Navy's belief system that underpins every decision involving maritime logistic support.

As far as possible, this document does not repeat doctrine from its higher precedents; instead, it focuses on the maritime applications and provides

.....

² Navy materiel capability consists of a wide range of assets, equipments and items. The term 'ships, submarines and aircraft' will be used throughout this document whenever 'operational effect' is invoked or implied, because these are the physical assets that deliver operational effect and they logically become the primary focus of maritime logistics.

them with richer context. It avoids well-worn acronyms, title case and definitions, preferring instead to use plain English, target enduring truths and logical argument. In Chapter 1, key words are in bold type.

The audience for this document is you. At whatever level you contribute to the enterprise this doctrine aims to engage you in the narrative. It should leave you with a deep understanding of the principles and a commitment to use them to deliver the required operational effect of maritime assets at sea at an optimum through-life cost. It cannot be continuously delivered without your individual understanding, generous contribution and deep commitment.

Chapter 1 sets the scene for Navy's belief system for maritime logistics. It comprises a set of principles, each with a narrative that builds on its predecessor to explain in plain language the dimensions and complexity of the inter-connected time, geography, technology, materiel and people elements of logistic support activity. The principles continue to be referenced through the doctrine where applicable. These principles are:

- **Principle 1:** Keep sight of operating intent
- **Principle 2:** Acquire reliable ships, submarines and aircraft
- **Principle 3:** Provide seamless support across the life cycle
 - **Factor 1:** Define reference functions to be performed
 - **Factor 2:** Provide coherent documentation suite
 - **Factor 3:** Employ whole-of-life performance framework
 - **Factor 4:** Design accountable materiel delivery organisations
- **Principle 4:** Aggregate views of acquired capability
- **Principle 5:** Consolidate class-by-class accountabilities
- **Principle 6:** Maintain tight configuration control in a continuously changing environment

-
- **Principle 7:** Optimise end-to-end supply chain to fleet and class demands
 - **Principle 8:** Manage by total cost of ownership throughout the life cycle
 - **Principle 9:** Generate a positive seaworthiness delivery culture
 - **Principle 10:** Achieve good asset stewardship through continuous improvement.

AIM

This doctrine describes Navy's enduring maritime logistic principles that, when applied consistently, will assure ship, submarine and aircraft sustained operational effect at an optimum through-life cost.

SCOPE

AMD1 Chapter 11 – *The Enablers of Sea Power*, lists three enablers, namely:

- Organisation and structure to deliver combat capability
- Effective relationship with industry as a key element in delivering this capability
- Maritime logistics to ensure that combat forces meet their operational requirements.

AMD2 *Logistics Support to Maritime Operations* Chapter 6 - *Maritime Logistics* expands on the AMD1 enablers as follows:

- Maritime logistics ensures combat forces operating at sea and in the littoral region can be sustained to meet their operational requirements
- Maritime logistic support principles apply across fleet, ship classes and platforms to ensure that ships and units can work together in task groups when required
- Logistic support is essential to providing vital attributes of maritime force employment, such as reach, agility and flexibility.

AMLD addresses each of these enablers from a logistic support perspective to complement the essentially operational perspectives provided by AMD1 and AMD2. The reader is encouraged to review AMD1 Chapter 11 and AMD2 Chapter 6 to provide a good understanding of these perspectives.

The scope of this doctrine covers Navy's **maritime logistic** concepts, principles and governance arrangements that the enterprise applies to enable achievement of AMD1 and AMD2 requirements. "**Maritime**" is global, embracing all the world's navigable oceans, lakes, rivers and the space above them, including celestial stars and satellites for navigation, communications and targeting, and the atmosphere for flying, tracking targets, directing guns and guiding weapons. "**Logistics**" is equally global. The root of the word logistics is **logis**, meaning 'abode' or 'dwelling', and this is the meaning Navy applies to its logistics enterprise. The systems that provide the operational effect that ships, submarines and aircraft are designed to deliver are housed, maintained and nurtured in platforms that move independently at will, requiring only occasional replenishment of fresh provisions, fuel, explosive ordnance and equipment spares. Replenishment is provided at sea from afloat support vessels or from ashore by a logistic support enterprise that also supports external materiel maintenance and modifications when needed.

In AMLD, Navy considers logistics in two broad categories, namely **materiel logistics** and **non-materiel logistics**. Materiel logistics is concerned with the whole-of-life of an item, from its conceptualisation to its realisation, use, upkeep, and eventual disposal. This requires a detailed and accurate knowledge of the functional (what it was designed to do), product (as-built: what it can do) and certified (what it must do in-service) configuration baselines of the class, unit, systems and fitted equipment at all stages of the life cycle. Non-materiel logistics includes such aspects as operating support; personnel support; facilities and training areas; warehousing and distribution; and the provision of consumable items of supply (including but not limited to) food, fuels and lubricants and explosive ordnance.

AMLD also covers the Defence Seaworthiness Management System insofar as it relates to materiel. The materiel logistics delivery system

provides **seaworthy materiel** and the assurance system provides confidence in its seaworthiness. AMLD is mainly concerned with the materiel logistics delivery category (providing seaworthy materiel), including the skills and competencies to conceive, design, build, operate and support the assets and their supporting items through-life. As such, the doctrine is technology-focused, with engineering and maintenance disciplines supported by fully integrated supply chains. An integral element of this materiel logistics delivery system is the assurance system that provides the confidence that the activities by which the materiel is being designed, constructed, modified, and upkept are providing materiel that delivers the defined operating effect and sufficiently protects the personnel that use it from harm and the environment in which it is used from spoiling (assuring materiel seaworthiness).

AMLD STRUCTURE

AMLD is arranged as follows:

- **Foreword** by the Chief of Navy
- **Preface** provides a guide to the reader, the context of AMLD, its aim, scope and structure
- **Chapter 1** provides the ten enduring logistics principles to be applied to support maritime capability
- **Chapter 2** describes the integrated approach required to enable the provision of seaworthy materiel
- **Chapter 3** describes the concepts that drive the design of the support system and the enduring features and constraints of maritime operations
- **Chapter 4** outlines the governance mechanisms that assure command and control of the enterprise outcomes and outputs and explains how the support concepts are applied through the maritime capability systems life cycle.

1

CHAPTER



THE TEN ENDURING LOGISTICS PRINCIPLES TO BE APPLIED TO SUPPORT MARITIME CAPABILITY

PRINCIPLE 1: KEEP SIGHT OF OPERATING INTENT

Overview

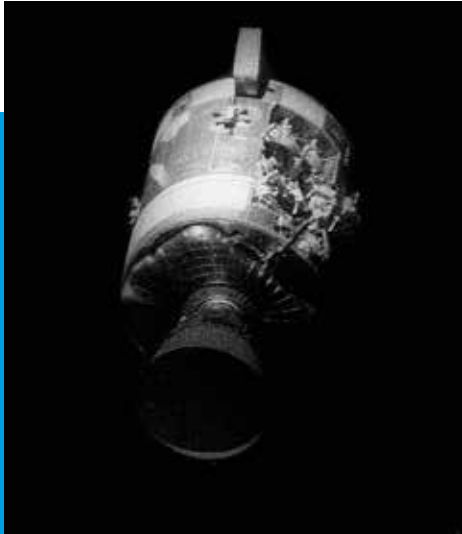
The first principle of maritime logistics is to respond to operational needs as they change through the long life of seagoing ships, submarines and aircraft. There is no point in keeping the logis in perfect working order if it is no longer attuned to the operational need. In order for Navy to meet this need, there is an obligation on the part of the ‘operator’ to document that need in the form of a ‘statement of operating intent (SOI)’ and to control its changes through life. Logistic staff then translate the operational intent to a logistic support requirement that can be feasibly delivered with the resources available. This continuous two-way communication between the operator and the logistician is the essential enabler of this principle.

Operational intent varies at all points in the asset life cycle, but the two significant periods are at capability concept and first-of-class capability usage at sea. The time period between those two events can be between three and ten years, or longer, hence the operating intent at the concept stage may well have changed³ by the time the asset has been delivered. The following paragraphs suggest the doctrinal approach to smooth out these discontinuities.

Capability concept

At capability concept the operator specifies much of the operating intent in an operational concept document. This focuses on the needed operational

.....
³ Particularly if the requirements for the use of the capability have been altered



APOLLO 13 EXAMPLE

An extreme illustration of a departure from operating intent followed Apollo 13's oxygen tank explosion shortly after launch and the consequential requirement to modify the moon-landing mission to an astronaut rescue mission. Lead

Flight Director Gene Kranz, under protest from the Command Module's designer, uttered "don't repeat to me what it was DESIGNED to do, tell me what it CAN do".

If we are to train as we fight, there will be times when ships, submarines and aircraft operate at the limits of their approved operating intent. Maritime logisticians (especially engineers and technicians) have a duty, however difficult, to advise commanding officers of the vessel's design limitations and its interpretation within the approved statement of operating intent whenever they have been breached or are in danger of being breached.

effect, the functionality of the mission system(s) required to deliver that effect, and the time and space required to sustain that effect. **Principle 2** expands on this aspect. The maritime logistician responds to the sustainment need in the form of an early 'support concept' which evolves as more information becomes available. Key decisions such as the

number of platforms, submarine or aircraft class, military or commercial off-the-shelf options (MOTS/COTS), local or overseas build, self-sustainment or largely foreign parent-Navy⁴ sustainment, high-tech / low-tech mission systems, inter-operability requirements etc. all play a role in formulating the support concept this early part of the process. This is the most critical stage in the life cycle, but the fact that these decisions offer such a broad range of combinations and permutations means that logistic support considerations are sometimes not specifically addressed early enough in the capability life cycle, leaving fewer options to pursue trade-offs and to develop the support concept at an optimised through-life cost. The maritime logistician needs to heed the principle of keeping sight of the operational intent and wholly participate in every decision that impacts on the future support environment of the new mission system.

Mission System Preparation for Operations

At entry into operational service the statement of operating intent for a mission system has assumed a maturity level that is close to the capability manager's (Chief of Navy) current requirements. The first-of-class mission system completes an operational test and evaluation program that validates the capability relative to the operational concept document through an objective assessment of its performance at sea, and an initial assessment of its support arrangements. This is the point at which the statement of operating intent is passed from Chief of Navy's direct oversight to the Fleet Commander's oversight. The Fleet Commander prepares the mission systems for operations in cognisance of this intent. Performing evolutions outside the parameters of the statement of operating intent can lead to increased strain on the mission system if it stretches the design envelope.

⁴ A parent Navy is the Navy of the nation that designed, built, and employed the mission system(s). Principles 2 and 4 expand on this.

Operations

The Fleet Commander provides prepared capability to Commander Joint Operations for the conduct of operations. When the force is assigned for operations, the same cognisance to operating in accordance with the Statement of Operating Intent (SOI) must be taken. Decisions to operate outside the SOI due to operational imperative should, where practicable, take into account the potential ramifications on the integrity of the mission systems. This is reliant on timely and authoritative advice to Command from engineering personnel.

Changes to design

Design change is a significant driver of sustainment costs and, therefore, design change must be closely scrutinised. The formal process for design change (addressed at **Principle 6**) applies to operators and maritime logisticians equally. Changes driven by operational needs require the same scrutiny and justification as changes driven by materiel needs, such as supportability or poor design. The maritime logistician needs to provide clear and substantiated analysis and advice on all change proposals to eliminate proposals that provide benefit that is disproportionate to total cost. The chaos⁵ generated by a change can be measured in the disproportionate amount of hours to process and implement it, compared with the minimal hours to process a maintenance transaction. The primary focus must be on sustaining the existing design, through the approved maintenance system, not changing it.

.....
⁵ Thermodynamics notes an increase in entropy, or chaos, during a change of state (such as boiling water to generate steam) and an increase in enthalpy, or stability, when energy is recovered (as when steam is condensed back into water). This is analogous to engineering change (an energy taker, to be avoided) and maintenance (an energy giver, to be encouraged).



Codification of Principle 1 – Formal collaborative planning

The collaborative planning objective is to ensure that maintenance, engineering and supply support change demands at the lower end of the decision hierarchy continuously meet the operational demands of the single and joint force commanders at the high end.

It is achieved when operational and logistic stakeholders meet formally

in an ascending level of decision-making about every two months over a recurring two-year cycle, with the common goal of delivering agreed operational effect. This business rhythm resonates in every operating and logistic decision up and down the end-to-end collaborative planning cycle, resulting in the formally agreed allocation of enabling resources. High level commitment to collaborative planning requires codification in orders and instructions and commensurate training effort to embed the best elements of cross-communication into our culture of Navy signature behaviours.



PRINCIPLE 2: ACQUIRE RELIABLE SHIPS, SUBMARINES AND AIRCRAFT

‘The emphasis on addressing logistics in the design process is based on the fact that (through past experience) a significant portion of the system’s life cycle cost can be attributed directly to the operation and support of the system in the field, and much of this cost is based on design and management decisions made during the early stages of system development. In other words, early design decisions can have a large impact on the cost of those downstream activities associated with system operation and maintenance. Thus, it is essential that logistics (and the design for supportability) be addressed from the beginning.’

Benjamin S. Blanchard

Logistics Engineering and Management (6th edition)

Inherent reliability

From a maritime logistics perspective planning for and achieving the acquisition of an **inherently reliable asset** is a fundamental goal. Inherent reliability is a direct consequence of good design. Good design is not cheap, but it is always good value, as it means fewer failures and longer intervals between failures, hence a much greater probability of repeatable operational effect. The benefits of high reliability are fewer spares carried and less corrective maintenance and increased operational availability, thereby enabling the technical workforce to be more gainfully employed on system grooming rather than defect rectification. For every small percentage increase in inherent reliability achieved at design source selection, there is potentially a significant reduction in materiel and workforce costs during the operation and support phase of the life cycle. The cost reduction benefits accrue as each vessel of the class enters operational service.

The importance of high inherent reliability at capability source selection cannot be over-emphasised. It is the single most significant driver of effective and affordable through-life logistic support before logistic support analysis has even commenced. Subsequent logistic support analysis during the acquisition process and in service can only optimise operational availability, not enhance inherent reliability, hence focused effort prior to source selection is needed in order to reduce through-life effort and cost later.

As with all design decisions, speed, endurance, strength, maintainability, durability, cost and weight are variables to be balanced in the whole of life materiel capability equation. Inherent design reliability in delivering the specified outcome is key, and engineers and logisticians must place it as an integral selection criterion for all materiel source selection activities.

Inherent maintainability and supportability

Other features of good design include inherent maintainability and supportability. Good maintainability means accessibility for repair and less mean-time-to-repair. Good supportability means designed-for-support, such as:

- between-decks equipment removal routes
- wide, unencumbered passageways with access for wheeled stores vehicles
- accessible, collocated store rooms, offices and workshops
- elevators and material handling equipment to reduce inefficient man-handling of stores
- large cool-rooms and freezers to meet Navy victualling endurance requirements
- enduring and viable materiel replacement supply chains.

All these features are readily apparent in ship design drawings or a walk around an existing ship of the class, but are only obvious to a maritime logistician charged with actually looking for them as part of the materiel source selection design assessment. Designed-for-support features, when found, reflect great credit on the designers: their worth cannot be over-stated, as they generally represent attention to detail in all aspects of the design. An absence or paucity of such features can be a significant discriminator at materiel source selection, as it casts doubt on the veracity of other claims in the offer.

The operational need is to acquire assets with affordable leading edge technology designed to maximise operational effect. **Principle 2** balances that pre-requisite by ensuring that capability managers acknowledge the need for repeatability of the operational effect by acquiring assets with high inherent reliability, maintainability, and designed-for-support features. This is at the heart of Chief of Navy's capability requirement to be ready today and prepared tomorrow. In the source selection criteria for new or upgraded mission systems the weighting factor for operational effect must be equal to the weighting factor for continuous sustainment of that operational effect. Operational effect is readily measurable: continuous sustainment less so because it takes a long time to verify in service.

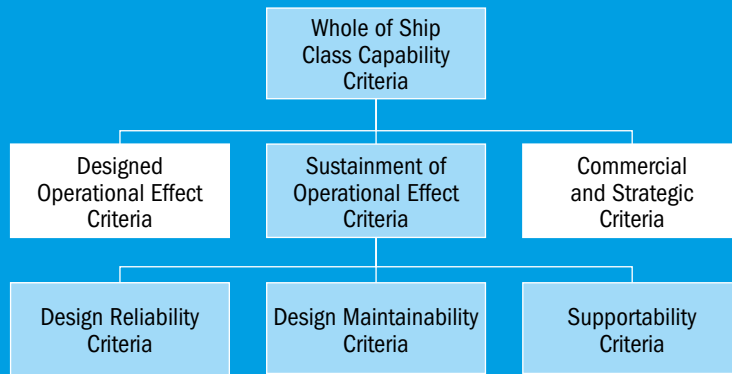


Figure 1 – Suggested maritime capability source selection criteria

The achievement of capability reliability at source selection

Given the importance of high inherent reliability at materiel source selection for a mission system, the following hypothetical example offers a method for its achievement that should leave no doubt as to its meaning. Consider the criteria for source selection and their weighting factors in this diagram.

In design selection, equal consideration should be given to ‘operational effect’ and the repeatability of that operational effect, with commercial and strategic factors also being taken into account. Within the sustainment-of-operational-effect criteria, demonstration of design

reliability should be a primary focus, with maintainability and supportability criteria also being key to optimising through life cost. Such a balance focuses tenderers’ attention on demonstration of the actual reliability of the design, not just on the integrated logistic support (ILS) deliverables⁶. Details of the proposed ILS contract deliverables should be considered in source selection, but as a component of maintainability and supportability. This must be made known to the tenderers in advance in the tender evaluation plan, to enable competitive responses based on a level playing field of known evaluation criteria.

⁶ This component includes ‘common equipment’ and ‘parent Navy’ support, which is further addressed in Principle 4.

In source selection the Commonwealth must draw the tenderers' attention to the requirement to demonstrate the achievement of operational effect and high levels of repeatability of that operational effect, which is the inevitable outcome of high inherent reliability. A smaller ILS package and a lower total life cycle cost are consequential, comparative benefits, despite the design and acquisition costs being higher.

Measuring design reliability, maintainability and supportability

The capacity to select an inherently reliable, maintainable, and supportable asset at materiel source selection assessment can be the difference between an inherently good design at good through-life value-for-money, or a compromised design requiring a lifetime of high cost support. It therefore demands an understanding of the measurement of these qualities.

Demonstration of maintainability and supportability features is realistically achievable and may be used to discriminate between like-designs. Demonstration of predicted reliability and maintainability, however, can only be achieved through functional block diagrams and computer modelling of these blocks in a dedicated reliability modelling tool. These are highly effective means of comparing like-designs. Verification of reliability and maintainability calculations are equally effective, the more so for seeking actual evidence from current asset owners, where applicable.

Principle 2 is the primary criterion for materiel source selection from a maritime logistics perspective. It demands that effort should always be made to influence the materiel source selection decision based on inherent design reliability above all other logistic factors. This assurance, however, may not be achievable where the source selection is directed. Navy nevertheless endeavours to achieve **Principle 2** through a thorough understanding of the fundamental importance of the lifetime benefits of high inherent reliability and an insistence on its inclusion as a significant source selection criterion. The lifetime rewards are worth the effort expended in achieving inherent reliability.

PRINCIPLE 3: PROVIDE SEAMLESS SUPPORT ACROSS THE LIFE CYCLE

.....

“The inadequate maintenance and sustainment practices have many causal factors. They include poor whole-of-life asset management, organisational complexity and blurred accountabilities, inadequate risk management, poor compliance and assurance, a ‘hollowed-out’ Navy engineering function, resource shortages in the System Program Office in DMO, and a culture that places the short term operational mission above the need for technical integrity”

Paul Rizzo
*The Plan to Reform Support Ship Repair and
Management Practices July 2011*

.....

Achievement of **Principle 1** and **Principle 2** has successfully selected mission systems with the potential to deliver repeatable operational effect because this is inherent in their design, and Navy has insisted on it in the materiel source selection process. Application of **Principle 3** will consolidate these gains by planning and implementing a whole-of-life approach to their support.

Source selection among a range of designs is one of the first significant milestones in the asset life cycle. The next is materiel acceptance and, shortly thereafter, operational acceptance. Transition through these milestones is inherently complex and can involve entities with quite different objectives and cultures. **Principle 3** offers ways to reduce these complexities.

The typical path to materiel and operational acceptance

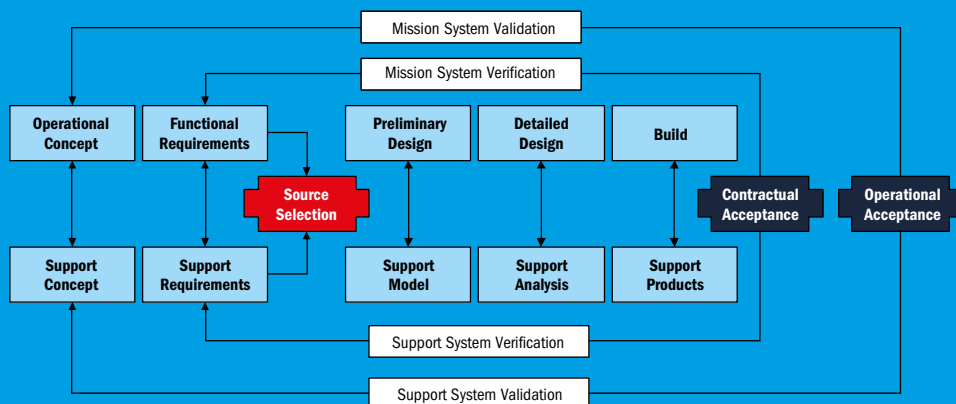


Figure 2 – Mission system and support system verification and validation process

On the path to materiel acceptance, functional requirements (e.g. ‘detect surface targets’) were allocated to major mission systems (e.g. search radar type ABC) as part of preliminary design, and subsystems were then integrated as part of detailed design. The logistic support concepts shaped a support model that permitted realistic trade-offs for decisions on optimum support solutions. Detailed logistic support analysis then generated actual support products intrinsically linked to the actual design and its predicted reliability (a source selection pre-requisite, per **Principle 2**). A reliability-centred maintenance process, using a reliability modelling tool and data supplied with the design at source selection, was used to develop maintenance requirements. Thereafter, technical and support

documentation, equipment assembly parts lists, ship allowance lists and support and test equipment requirements were determined and acquired to the limit of available resources. Initial workforce and training requirements completed the maritime logistics package concurrently with ship production, integration, design reviews and verification processes. While all Fundamental Inputs to Capability (FIC) are required to be addressed within the scope of acquisition management, not all aspects of the support system will be within scope of the prime acquisition contractor. This places a high degree of importance on the Capability Program Manager role in ensuring FIC integration is closely managed, particularly between contractual acceptance and operational acceptance.

The validation process by the end-user is designed to demonstrate that the vessel's actual performance at sea meets the defined operational concept and/or intent. For a very long period prior to this, the designer, builder, and its logistic support analysts achieved delivery of all services and products on a contractual basis and with limited contact with end-user staff. Differing understandings of capability requirements at delivery of the first-of-class vessel inevitably leads to deficiencies caused by false assumptions, flawed interpretations and the consequences of cost, schedule and quality pressures. This highlights the importance of clarifying assumptions and agreeing interpretations early in the capability life cycle as possible, and continuing to do so throughout the life of the capability. This requires close attention by the maritime logistician.



The complexity of satisfying user expectations

Despite shipbuilders' best endeavours, from the seventy-four-gun 'hearts of oak' in the 1770s to the guided missile destroyer 'brains of Aegis' since the 1970s, the logis into which each new class enters service is never the one that existed at contract signature and, not unsurprisingly, the support products delivered, from sail material to computer motherboards, do not always live up to end-user quality and quantity expectations at the time of delivery. **Principle 3** describes Navy's belief system for smoothing out transition issues that may occur as Class assets move from the capability development

phase to the design/build phase; thence to the employment phase (where the operational and support needs must be balanced); and finally, to the disposal and transition phase. Good application of **Principle 1** will assist with this transition process, as it encourages a forward leaning maritime logistics ethos, and **Principle 2** drives the delivery of inherently reliable assets that reduce the size, cost and complexity of the logistic package. Clear and unambiguous articulation of capability requirements early in the life cycle will reduce the delta between user expectations and reality – if user requirements are not explicitly specified, they are unlikely to become contract deliverables.

Life cycle support factors

A notional ship class life cycle is about 50 years: 5 years to identify and thence define the need for the new or additional capability it must deliver; 5 years to develop the detailed specification for it and achieve approval to proceed; 10 years to design/build/acquire it, 30 years to use it and a few years to dispose of it. Multiple new ship class developments/acquisitions, plus major and minor upgrades and updates to existing classes are all occurring concurrently, each at differing stages of this phase of the life cycle. The fog of program management can easily hide from sight the principles this doctrine is trying to express in clear and simple terms. Assuming **Principles 1 and 2** are being put into practice, **Principle 3** depends on four additional factors, namely:

- **Factor 1** – a stable set of reference functions that the whole logistic enterprise has to perform
- **Factor 2** – a coherent set of documentation stemming from this doctrine, down through Defence Instructions, Navy Instructions, policy, procedures, handbooks, local orders, plans and work instructions that guide and direct the performance of these functions
- **Factor 3** – a whole-of-life performance framework against which to measure operational effect (the operator's metrics) and the repeatability of that effect, including safety of personnel and protection of the environment at each phase of the life cycle
- **Factor 4** – a single class-by-class, accountable materiel delivery organisation that performs the functions and responds to the measured logistic performance at each phase of the life cycle.

Each of these factors is explained below in enduring doctrinal terms, not regulatory or policy terms. The logistic enterprise must work out the solutions that provide the best outcome across the multiplicity of Classes.



The Loss of RAF Nimrod MR2 Maritime Aircraft XV230

“Huge organisational changes took place in the Ministry of Defence in-service support and airworthiness arrangements for Defence equipment and Royal Air Force aircraft in the years prior to the loss of XV230. There were three major themes at work:

(a) a shift from organisation along purely functional lines to project-oriented lines ;

Principle 3 Factor 1 places management of functions (WHAT is to be performed) above project-oriented matrix management.

(b) the ‘rolling up’ of organisations to create larger and larger ‘purple’ and ‘through-life’ management structure

Principle 3 Factor 3 and Factor 4 places management by Ship Class (i.e. deep knowledge and skills by small organisations that can reach out to other experts) at each phase of the life cycle above single organisations for through-life management.

(c) ‘outsourcing’ to industry.”

Principle 3 Factor 4 and Principles 4 and 5 advocate suitable tailoring of Class support models, but do not advocate which functions should be outsourced. Configuration control, however, remains a function for which the Department of Defence remains accountable per Principle 6.

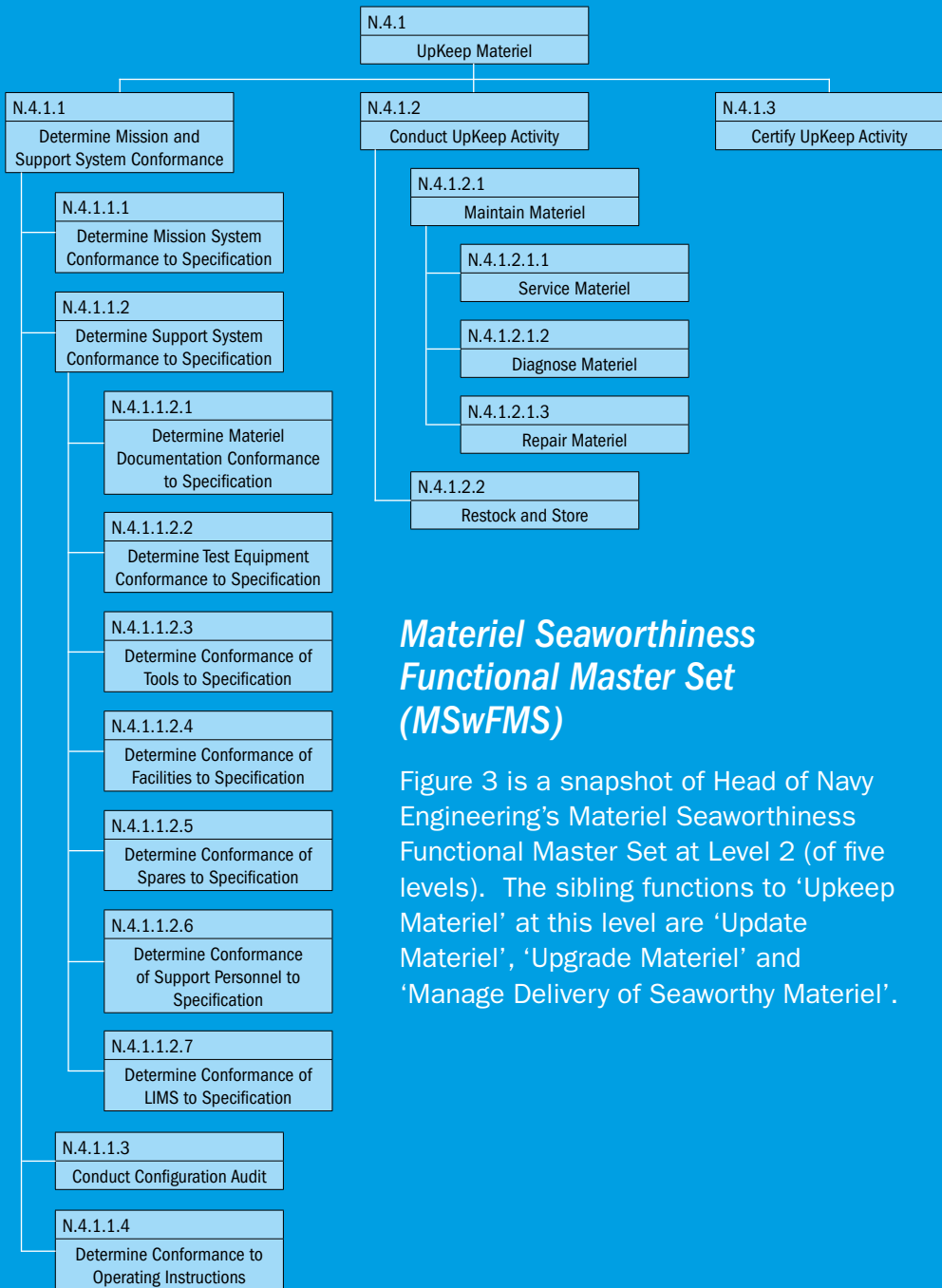
Charles Haddon-Cave QC

The Nimrod Review October 2009 - an independent review into the broader issues surrounding the loss of RAF Nimrod MR2 Maritime Aircraft XV230, and loss of life of 12 crew and two specialists in Afghanistan in September 2006.

PRINCIPLE 3 FACTOR 1: DEFINE REFERENCE FUNCTIONS TO BE PERFORMED

Factor 1 comprises a documented, configuration managed, master set of hierarchical 'verb-object' functions to be performed by the logistic enterprise from capability concept to disposal.





Materiel Seaworthiness Functional Master Set (MSwFMS)

Figure 3 is a snapshot of Head of Navy Engineering’s Materiel Seaworthiness Functional Master Set at Level 2 (of five levels). The sibling functions to ‘Upkeep Materiel’ at this level are ‘Update Materiel’, ‘Upgrade Materiel’ and ‘Manage Delivery of Seaworthy Materiel’.

Figure 3 – Example of ‘Upkeep Materiel’ Function

A Functional Master Set of any enterprise, whether it is Government, Defence, Navy or Naval Engineering, requires approval, ownership and active direction by the head of the enterprise, coupled with an assurance system that reports on its correctness and correct application by all organisations and individuals within the enterprise. The enterprise needs clear definition such that the functions within one enterprise (eg engineering requirements) are not being shared by other enterprises (eg training delivery).



Example of a Whole of Navy Functional Master Set

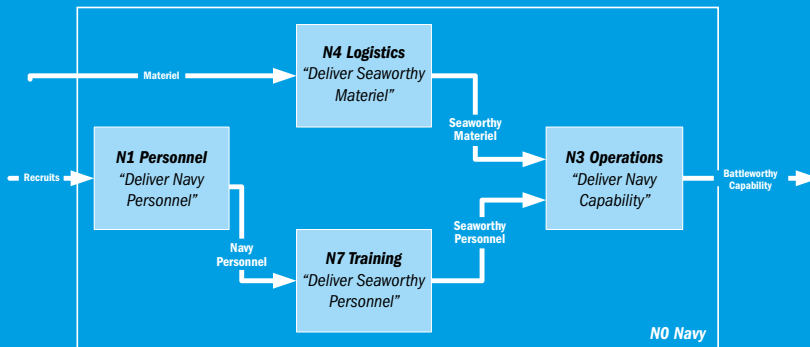


Figure 4 – Example of relations between Navy Enterprises

Figure 4 illustrates how Navy, as the ‘mother’ enterprise, could be viewed as individual, inter-connected enterprises, each contributing a primary function defined by the Common Joint Staff System (CJSS) code⁷.

The figure illustrates where the N4 maritime logistics enterprise fits in a functional context to deliver its materiel component of the whole NO Navy enterprise. The location of the functions in the model is unimportant. The inputs, outputs, constraints and mechanisms (ICOMS) of each function, however,

are crucial to the effective delivery of end outcomes. N3 Operations (Raise, Train, Sustain), for example, combines seaworthy materiel and items of supply with seaworthy personnel (and other inputs from N2 Intelligence and Security, N5 Plans and N6 Communication and Information Systems not shown) to deliver battle-worthy capability to meet preparedness requirements. Ideally, each of these NO to N9 Navy enterprises (and other Defence enterprises) should be modelled in a similar way to N4 Logistics, and then all of the functions and ICOMS would begin to interconnect to illustrate each of their functional inter-dependencies without shared functions, duplication or ambiguities.

⁷ Australian Defence Doctrine Publication (ADDP) 00.1 describes the CJSS code adapted from the North Atlantic Treaty Organisation (NATO) Joint (J) staff system. The CJSS supports the commander in achieving the mission and end-state.

PRINCIPLE 3 FACTOR 2: PROVIDE COHERENT DOCUMENTATION SUITE

Factor 2 comprises a suite of documentation that drives the logistic enterprise down a common path to remain coherent and consistent with this doctrine, while also complying with every applicable Defence and Navy requirement. Achievement of these two conditions may seem insurmountable, given the vast range of Defence policy instruments and their underlying publications on related and applicable logistics subjects; however, the two conditions are not incompatible. This doctrine establishes principles for applying the Defence and Navy policy instruments in the maritime logistics domain; it does not create any policy or contradict them. If the document suite is coherent and consistent with this doctrine, then both conditions are satisfied and the document suite is guided by the maritime logistics principles herein.

PRINCIPLE 3 FACTOR 3: EMPLOY WHOLE-OF-LIFE PERFORMANCE FRAMEWORK

Factor 3 comprises a performance framework that connects all functions at all phases in the asset life cycle. It is ‘anchored’ by the Functional Master Set and a materiel ‘body of knowledge’, comprising Navy’s complete set of standards and codes of practice from which individual classes derive their unique set.

The ‘framework’ is the critical enabler for any performance model, but is often overlooked or over-simplified because it gets too ‘complicated’. Resolution of complexity in this instance is necessary because of the number of critical variables in play. A good performance framework is a genuine ‘force multiplier’ for the continuous delivery of logistic goods and services in a constantly changing operational environment.

Selection and measurement of the right reference and control KPI provides a finely tuned performance management system for all ship classes that drives their resource requirements accordingly. Measurement must be

undertaken from the outside-in: that is, whole-of-life KPI must be satisfied first, 5-year KPI second, and annual KPI third. Any variation to this sequence has the potential to generate instabilities, large step-functions of inequalities and an unfair distribution of resources between classes. The framework demands whole-of-life considerations before all others. Consistent application assures an optimised continuous repeatability of operational effect that exactly matches operational priorities.

Any KPI selected that cannot be directly or indirectly linked to enterprise performance should not be used. Every KPI requires time and energy to measure, analyse and report, hence is an overhead to be minimised unless it adds real value to the enterprise.

KPI example

A KPI such as 'demand satisfaction rate' for spare parts that have been demanded by a ship does not provide detail on the relative importance of those demands. A slight modification such as 'demand satisfaction rate of critical items' becomes more interesting and high performance can have a direct impact on operational effect; hence, it is of high value. Second and sometimes third order computer effort (a low overhead, once the algorithms have been inserted) can automatically and continuously measure this high-value KPI. There is also a direct connection to source selection discussed in **Principle 2**. Critical items in

critical systems derive directly from the source selection reliability modelling data, combining top-down failure modes and effects analysis (FMEA) (to find critical systems) and bottom-up failure modes and effects criticality analysis (FMECA) (to find critical items within critical systems). The data is re-used in-service without any discontinuity between the life cycle phases of capability development, acquisition and operation. This data must continue to be verified and amended in-service through failure reporting analysis and corrective action (FRACA) and data collection, analysis and corrective action (DCACA). KPI data collection is resource-hungry. Select and use KPIs and KPI data wisely.

PRINCIPLE 3 FACTOR 4: DESIGN ACCOUNTABLE MATERIEL DELIVERY ORGANISATIONS

The fourth factor is the maritime logistics workforce that actually performs the functions in accordance with the documentation, within the limit of the priorities and resources calculated by the performance management system in response to operational requirements, and as approved by the relevant authorities. The workforce comprises all applicable members of Navy, Defence and Defence Industry. This doctrine provides no guidance as to who should perform which functions: this can and ordinarily will vary from class to class. With the exception of seagoing positions in ships and certain functions requiring Department of Defence authority, the only other prerequisite is that positions are occupied by personnel with the requisite authority, qualification, experience and currency, whether this be by uniformed, public service or contractor personnel. The required authority and competencies⁸ for each maritime logistics position must be established by the head of N4 Logistics as a workforce need, and those needs must then be satisfied by the leads of N1 Personnel and N7 Training, as illustrated at Figure 4 - Example of relations between Navy enterprises.

An overarching principle for the organisation of the maritime logistics workforce at the 'operational', or waterfront level, is that it be deeply committed to, and collocated in the homeport of, the ships and submarines that it serves. This commitment continues regardless of whether the vessels are highly visible and alongside in the homeport or absent and deployed for months. Coupled with commitment is deep knowledge, to the extent of technical mastery, of the vessels the workforce serves. The organisation must be class-based, as far as resources will permit, such that this deep knowledge is nurtured, professionally developed and retained, even though personnel cycle through it. Then, and only then, can the delivery organisation at the waterfront be deemed 'accountable', and be assured as such. **Principle 5** expands on this

⁸ Competence = qualification + experience + currency

theme. Engineering, maintenance and logistic support analysis functions at a fleet level to back up the class delivery organisations also need consideration in the form of technical bureau organisations. **Principle 4** expands on this theme.

A class materiel delivery organisation must respond to operational requirements determined by the operating authority, per **Principle 1**. It therefore requires strong Navy executive leadership by the Capability Manager's Representative, supported by logisticians, to further define requirements. The class materiel delivery organisation requires high levels of dedicated engineering, maintenance and logistic support competencies linked with dedicated (or shared) contracting and financial management competencies. Linkages between all entities that play a role (supported and supporting) should be documented in a resourced agreement with an attached schedule of products and services to be delivered. The agreement and the schedule should be reviewed on a rolling basis as part of the formal collaborative planning process discussed at **Principle 1**.

The concept 'Ship zero' is the name given to Navy's capability support concept of 'sustaining where you operate'; that is, collocating key supporting agencies, training capabilities and industry support centres with the operating waterfront base as far as reasonably practicable. Ship zero additionally accommodates the land based test site and systems development cell including the finite element and electronic product model. It enables a better understanding of the design intent and the consequential knowledge base with which to continuously improve training, sustainment and capability assurance requirements and facilitate a continuous shipbuilding environment. The objective is to maximise the proven operational, upkeep and business effectiveness and efficiencies that result from such inherently domain knowledge-based support models. Navy is embracing the ship zero concept for all future capability acquisition and sustainment programs.

PRINCIPLE 4: AGGREGATE VIEWS OF ACQUIRED CAPABILITY

Principle 3 established the doctrine of seamless support across all phases of the asset life cycle. **Principle 4** aims to tailor this in recognition of the different mission systems and their home port locations around Australia. **Principle 3** applies across all mission systems and locations, but the logistic support demands vary between different capabilities. Effective and efficient support demands suitably tailored support models.

Surface and subsurface combatants comprise destroyers, frigates, mine-hunters, patrol boats, amphibious ships and submarines. These are generally built to military specifications, sometimes incorporating commercial off-the-shelf items, and requiring a system-level design that delivers to unique requirements such as:

- combat system alignment to achieve their operational effect
- explosive ordnance stowage, handling, and use
- shock absorption
- damage control and recovery
- Electromagnetic emission control and radiation protection.

As such, their logistic tail is specialised, heavily technical, and can involve long lead times. They have shore support systems devoted to simulation, demagnetising, vessel characteristic measurement (ranging), software development, rescue, testing and trialling. Each class-type support model is largely determined by its parent mission system's genes, or design, at conception and irreversibly delivered at birth, which, for the maritime logistician, is at source selection. **Principle 2** highlights the importance of this decision and the influence that the maritime logistician must exert on it. The vessel's inherent reliability, maintainability and supportability has already been determined by design and is largely fixed for life. The support model for the rest of its life can only be developed by competent maritime logisticians to plan for and implement a sustainable future.

Surface non-combatants comprise replenishment ships, hydrographic survey ships, special purpose support ships, auxiliaries and tenders. These ships and boats have elements of combatant capabilities, sometimes including guns, military communications, fuel and ordnance stowage etc., but are generally less complex units. Collectively, however, and due to their diverse range of size, technology and origin, they are, in themselves, an inseparable mission support capability for the combatants and require appropriate treatment in the design of their support models and the allocation of support resources per the logistics performance framework.

The aggregate view of acquired materiel forces a continuous review of the standard class support model per **Principle 3** and the class-type support model (grouping like-classes) discussed above. On balance, combatants, due to their extremely specialised mission systems, lean toward dedicated class support models for each class, whereas non-combatants may be more effectively supported by a type-based support model (e.g. all replenishment ships, all hydrographic survey ships, etc.). These decisions are largely determined by available resources, but the various technologies must be considered to avoid dilution of mastery in strategic technology areas. The aggregate view lends itself to a centralised contracting and financial management function, servicing all classes and class types, as the principle user of the common logistics performance framework at **Principle 3 Factor 3**. Whole fleet priorities and consequent resource allocation based on whole-of-life metrics, followed by 5-yearly metrics and finally annual performance metrics can be more strategically managed from a central organisation with regional representatives rather than a distributed finance organisation. This provides the Capability Manager's representative with a better big-picture view, enabling informed capability/cost trade-offs.

Three further considerations of the aggregate view are the parent Navy view, the common equipment view and the common fleet configuration data view.

- **Parent Navy considerations.** Where a class source selection decision was strongly influenced by the maturity of the logistic support offered by the Navy/industry of origin (termed the ‘parent Navy’), then the support model should necessarily be tailored to make the most efficient and effective use of that offer. Consequently, the support model may have features that differ from the ‘common’ model.

.....

“The term ‘parent navy’ encapsulates the full responsibility and burden for all elements of integrated logistics and technical support through the capability life cycle of a platform (cradle to grave approximately 40 years). It requires commitment of considerable resources and a broad range of specialist skills, knowledge and experience. In the past, the RAN was provided this support by the RN and, more latterly the USN, as they were ‘parent navies’ for most of the ships in service with the RAN. The RAN accepted the responsibility of being the ‘parent navy’ for three classes of vessel in rapid succession (Collins, Anzac and MHC) without any increase in establishment or funding to allow it to meet the additional responsibilities and long-term workload it had taken on”.

Report on the Strategic Review on Naval Engineering 12 November 2009

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- **Commonality of equipment.** Each class or class-type support organisation must recognise that certain common equipment fitted in every vessel, or groups of vessels, such as selected safety equipment, radios, diesel engines, gas turbines, pumps, etc. may be more efficiently and effectively managed by a materiel cross-platform support organisation than by each class support organisation itself. This can lend a degree of complexity to who is accountable for support of which parts of the vessel if that accountability is not agreed across the classes and clearly documented. **Principle 6** expands on this configuration interface issue.
- **Common Fleet configuration data.** The final aggregate capability consideration, and the one most difficult to resolve, is the common fleet configuration data view. Historically, ships were built and delivered with hard copy as-built drawings, parts lists and support items unique to each platform. With the development of relational computer databases the practice continued, such that each ship of the class was a separate

database clone of its predecessor, achieved by copying the previous unit's database and making minor changes to its data following a configuration audit of the build. This method was cheap, efficient, and generally met the functional requirement for acquisition. For in-service support, however, it created more issues than it resolved.

The challenge of a fleet view of Class configuration baselines in a single database

Cloned ship databases did not permit a 'class' view of the configuration baseline data. Every class configuration change and every repair-by-replacement job required access to various databases, each with duplicated data about the same equipment. This duplication increased the likelihood of manual data entry errors, gradual dilution of data integrity, and diminished confidence in the data by

maritime logisticians. The class data view has generally been achieved through use of the ship applicability method, meaning that ships are assigned to configuration items (equipment), not the other way round. Extending this applicability method to a whole fleet data view has yet to be achieved in the RAN, but a better understanding of the requirement and an increased experience among sustainment configuration managers has created an organisation with a strong appetite to get there. This will enable the common logistics performance framework at **Principle 3 Factor 3** to work continuously in real time.

A pre-cursor to class support is knowing what is being supported in every ship of the class, including each item's current physical and functional configuration status, down to the unique serial number of fitted items, those in store, and those in the repair loop. The aggregate view of Navy's diverse materiel requires a logistic enterprise with the right mix of support models guided by **Principles 3 and 4**. Navy must concurrently seek to manage its information from a single source of truth in the form of a fleet configuration baseline that can view multiple class and unit baselines in real time as needed in any global location. **Principle 6** expands on this theme.

PRINCIPLE 5: CONSOLIDATE CLASS-BY-CLASS ACCOUNTABILITIES

Principle 3 discussed Navy’s enduring belief in a class-based support model and **Principle 4** discussed considerations that might modify this into a support model comprising a group of ships of alike type. **Principle 5** deals with the management issue of accountability across all classes once the support model has been determined. Accountability in this context means which individuals are responsible for the high level outcomes for each class or group support model and what, specifically, are the outcomes for each. The clear understanding and consistent application of this principle is fundamental to a well-designed and executed support model.

Figure 4 - Example of Relations between Navy Enterprises showed the overall outcome of the N4 Logistic enterprise is “seaworthy materiel”. **Principle 2**, stressing the importance of reliability, further defined the outcome as “assurance of repeatable operational effect”, this being a primary component of “seaworthiness”. This top level outcome must be clear across each class and/or group support organisation. The enduring subordinate class and/or group outcomes that contribute to this enterprise outcome are:

- a clear understanding of operational needs, derived from operating intent and plans
- a clear codification and resourcing of logistic support mechanisms to meet operational needs and requirements
- correct attitudes and behaviour in performing logistic functions
- engineering decisions based on whole-of-life support needs
- maintenance decisions based on engineering direction
- support decisions based on value for money and taking into consideration aspects such as risk of obsolescence.

Accountable individuals

Against each of these six subordinate class and/or group outcomes there must be a single accountable person. This accountability prevails continuously through each phase of the asset life cycle from concept to disposal. The accountability applies from top end instructions and policy down to end-user implementation at sea or ashore across the whole range of applicable disciplines and Defence and industry organisations. The accountable person does not necessarily perform the logistic function, but is ultimately accountable for the performance of the applicable functions, assurance that they are performed, and delivery of the defined outcome.

Principle 5 seeks to consolidate all of the precedent principles through the individuals accountable for class outcomes. There is no intention here to forensically specify the outcomes or the titles of the accountable individuals, but some detail has been provided to describe what are considered to be the six most important accountabilities.



PRINCIPLE 6: MAINTAIN TIGHT CONFIGURATION CONTROL IN A CONTINUOUSLY CHANGING ENVIRONMENT

Principle 3 discussed Navy’s enduring belief in a class-based support model and **Principle 4** discussed considerations that might modify this into a support model comprising a group of like ship-type classes. **Principle 5** deals with the management issue of accountability across all classes once the support model has been determined. Accountability in this context means which individuals are responsible for the high level outcomes for each class or group support model and what, specifically, are the outcomes for each. The clear understanding and consistent application of this principle is fundamental to a well-designed and executed support model.

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“It is not the strongest or the most intelligent who will survive, but those who can best manage change.”

Charles Darwin

.....
Charles Darwin drew this conclusion about the evolution of life forms on earth over many millions of years. We universally recognise the truth of his belief that the species which could best adapt to its changing environment would survive and prosper. Principle 6 maintains that the logistic enterprise survives and prospers on its capacity to manage change as a normal feature of its day to day business.

Principle 1 observed that “there is no point in keeping the logis in perfect working order if it is no longer attuned to the operational need”. In the Navy context, fighting and winning at sea is about maintaining the technical edge and delivering it with the right operational effect exactly where, when, and for as long as needed. Maritime logistics must enable the delivery and repeatability of operational effect.

Standards, instructions, plans and handbooks provide excellent sources of reference to current international practices of configuration management, data systems architecture, data management practices, data integrity preservation, data security and data protection. The enterprise must draw on these standards in defining the logistics functions it will execute, and ensure the availability of competent personnel to understand and adhere to them. Similarly, the class materiel delivery organisations must ensure a 'right size' data integrity team to maintain complete records of the class and unit configuration baselines. These records must remain under tight control. In this context 'tight control' means that no documentation or data is released to the end-user without the accountable manager's authorisation in accordance with a local release protocol. Change control is only possible if one is sure of the 'genetic' makeup of the item one is changing. It is part of the configuration manager's job to manage an item's change history and current modification status from original entry to the configuration management system until its archival. Hence the importance of adherence to the approved release process, such that there is only a single source of 'current' class configuration truth.

The critical item that enables **Principle 6** is its supporting information management system. The logistician's ability to support maritime capability in the 21st century hinges on the control of information dedicated to that purpose. **Principle 6** describes in doctrinal terms the characteristics of the logistic information management system that provides the logistic enterprise its winning technological edge. Navy must respond to changing technology requirements when the evidence supports the need.

It is important to understand why the logistic information management system is the critical enabler in the change process. Configuration change planning, identification, change, status accounting and audit are the component disciplines of configuration management. All disciplines centre on the configuration item, which has a special meaning in the logistic enterprise. The class logistic information management system centres on the collection of configuration items that combine in hierarchical parent-child-sibling relationships to define the class, the ships and systems within

the ships down to, generally, the lowest replaceable units or assemblies. Surrounding each configuration item data entity at all levels of the hierarchy are the logistic support data entities, including documents⁹, spares, support and test equipment and training material. When actual configuration data fills this system, the functional and product baselines for the class have been established. Class configuration identification has been achieved and must be maintained through-life.

Principle 6 requires lifetime traceability of class configuration identification, including

class physical/functional change needs and requirements

change approval

change implementation

change verification

change acceptance

class baseline data change update

from entry into the configuration management record until deletion to archives.

These are essentially engineering configuration management processes and require an engineering discipline applied by a single class engineering, construction/modification, maintenance and support organisational entity from concept to disposal, as responsibility for the management of class assets transitions between capability development, acquisition, sustainment and disposal phases. The common threads are:

- the documentation and data to support the class configuration baseline through life
- a class configuration manager to maintain and release the data

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⁹ Including such documentation as Design, FMEA, manufacturing, test, maintenance regime/ instructions, operating instructions, transportation instructions, storage instructions, handling instructions, disposal instructions

- a class materiel delivery organisation to implement the constituent functions of the Capability Manager

Configuration changes are driven by a wide range of factors such as:

- change in operating intent
- a change of function
- a change of equipment
- a change to a document
- a change of spare parts.

These changes may be triggered by a range of factors, including such aspects as Original Equipment Manufacturer (OEM) recommendation, safety issues, updates to usage/RAM data, obsolescence, errors in original documentation, etc. Each of these changes generates a cascade of change to other interconnected items. Each must be traced from top to bottom.

Ship example of equipment modification impact on spares allowance and stock

For a single modification to an equipment, some spares may need to be permanently withdrawn from the ship's allowed onboard stock, other spares added in their place, and some spares retained in the wholesale inventory stock for those other ships still waiting for

the same equipment modification some years into the future. The fleet configuration management tool must track in real time, which ship class and units have the equipment fitted, where it is fitted within the unit (or in the repair loop ashore), what its current modification status is, whether the onboard spares and consumables allowance reflect its modification state, and that the onboard stock conforms with the allowance.

This simple example hints at the complexity of the change process, which requires a robust logistics information system to effectively control. The logistic information management system in its normal mode of operation has to be capable of capturing every change, as well as accommodating temporary changes in the form of variations from the standard condition for a particular mission or a trial or temporary unavailability of a recognised part/spare. For each type of change process, an end-to-end workflow from user justification, to approval, to implementation, to user receipt, acceptance, implementation, re-baselining and re-stocking where necessary must be embedded in the logistic information management system and where no transaction or function of the workflow is discharged outside of the LIMS tool. Off-line excel spreadsheets and databases cannot effectively substitute for an online real-time transaction-based tool for the whole logistic enterprise.

In the maritime environment, 'real-time' is a nominal concept, as ships and submarines are rarely in day-to-day communication with shore systems. Data transmissions are sometimes 'batched' on a daily basis, and bandwidths are usually limited, at best, hence the logistic information management system tool has to cleverly deal with data updates sometimes days or even weeks later and maintain data synchronisation. These are known as 'deployable' information systems. Their design must accommodate interrupted communication periods whilst assuring reliable transmission quality and zero data corruption when communication windows are open or re-open. The design must also allow for accurate and disciplined data synchronisation between instances of the tool when connection/exchange occurs. The maintenance of tight configuration in this environment is the real test of the logistic information system. The slightest data error drives the next divergence.



PRINCIPLE 7: OPTIMISE END-TO-END SUPPLY CHAIN TO FLEET AND CLASS DEMANDS



Cornelis Stellingwerf, a principal logistic consultant in the ANZAC Ship Project Office 1990-92, and a legend in his lifetime to those privileged to work with him worldwide, drew this conclusion following two years working in and for a German patrol boat squadron plotting in real time the links between operational downtime and its causes. The '80%' statement is often used but had never previously been actually verified with hard data, as it is very difficult to capture the actual start

"80% of operational downtime is waiting for spares."

Cornelis Stellingwerf

and stop times of downtime and its related delay time causes in multiple units in real time. Stellingwerf measured this and discovered many other statistics about cause, effect and corrective actions to reduce operational downtime. Further correlation with European and South American Navies drew consistently similar conclusions. In the absence of Australian Navy corroborating data, this doctrine will assume the statement to have relevance across the fleet.

It immediately focuses attention on the need for a smart, responsive, supply chain, as this is critical in achieving repeatability of operational effect.

Principles 1 to 6 inclusive all contribute significantly to the optimisation of the end-to-end supply chain.

- **Principle 1 – Keep sight of operational intent** means being pro-active in carrying the right types and quantities of spares for the mission. Operating in company with support vessels, ships of the same class, and access to a helicopter for ship-to-ship transfers are force multipliers permitting a mix-and-match of high value, low (or nil) allowance additional critical items across the task force. Forethought and constantly challenging and updating stores allowances for the mission can achieve the right mix of spares holdings prior to deployment and should be exercised frequently and routinely as a ship evolution so as to force that delay time down to an acceptable level.
- **Principle 2 – Acquire reliable ships and submarines** ensures that there is less risk of failure and fewer spares needed. Nevertheless, spares, when needed and when not embarked for immediate availability, will suffer exactly the same statistical delay time as less reliable ships unless Principle 1 is exercised with vigour.
- **Principle 3 – Provide seamless support across the life cycle** will assist greatly in reducing the downtime. The logistic enterprise will be performing the right functions with the right documentation, (as assured through a performance framework) managed by a class accountable materiel delivery organisation. Importantly, it will be measuring the right things to understand where its delays are occurring so that it can address them. Note again Principle 3 Factor 3 KPI example relating to ‘demand satisfaction rate of critical items’.
- **Principle 4 – Aggregate views of acquired capability** notes the importance of a “single source of truth in the form of a fleet configuration baseline that can view multiple class and unit baselines in real time as needed in any global location”. Just knowing, on a fleet view, what is fitted where, and what is in the repair loop or procurement process in real time, offers more options that can significantly reduce delay times for replenishment when urgently needed.

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- **Principle 5 – Consolidate class-by-class accountabilities** puts the onus fairly and squarely on the accountable Class Principal Logistic Support Manager. All of the above initiatives to reduce delay time rest on his/her shoulders alone.
 - **Principle 6 – Maintain tight configuration control in a continuously changing environment** is self-evident. Note again the complexity of maintaining control of the spares requirements when equipment is modified. Without tight configuration control and a responsive deployable logistics information management system, it is not possible to reduce the delay time.

Notwithstanding the primacy of **Principles 1 to 6**, there are things that must be done with the end-to-end supply chain as a matter of doctrinal necessity including:

- continual through-life review of allowances based on (actual reliability, changes in equipment employment)
- linking configuration changes to analysis of and changes to spares allowances
- ensuring that stocks held in all locations conform with allowances
- timely spares (and other items of supply) requisitioning
- releasing repairable/refurbishable spares for maintenance
- driving and monitoring the supply chain.

Selection of equipment spares and the calculation of allowances for a ship and a class is a logistics function through-life. The calculations are initially based on reliability modelling of the design and reliability-centred maintenance methods to determine preventive and corrective maintenance requirements. In-service amendments are subsequently based on usage rates and engineering analysis, requiring continuous collaboration between engineering, maintenance and supply staff. Forcing delay time down is a function of having the right spares in the right


quantities in the right units of issue in the right place. Engineers have an ongoing responsibility to not just assist in the process, but to drive the process.

Configuration change management workflows must directly link to Navy or Defence spares allowance/ entitlements systems, such that any configuration change that involves a change to the assembly parts list of an allowed spare is an integrated process that prompts spares allowance redetermination. This should be the only permissible process to add to, allow substitutes for, or delete items from the spares allowance.

High level conformance of onboard and external spares with allowances for those spares is an essential pre-requisite to driving down the delay time and the consequential operational downtime. A regular (daily) audit of this conformance, particularly of identified critical spares, is a key indicator of readiness today and preparedness tomorrow. Logistic information management systems must support, and where possible, automate this audit as a minimum requirement.

Spares required for preventive maintenance need to be ordered in a timely and predictive manner, and timeliness is also critical in ordering spares for corrective maintenance. Late requisitions by maintainers drive late job acquittals contributing to the 80% of operational downtime waiting for spares. The supply system cannot be held accountable for tardy requisitioning.

Ships and submarines in deep maintenance periods also need spares. Staff may see it as good practice to closely control the release of spares to support operational vessels only, and not to ships in deeper maintenance. This can contribute to late maintenance task acquittals on vessels undergoing the deeper maintenance, thereby causing complex cumulative delays in system set-to-work, test and tune, harbour and sea trials and release for operations. Accountable managers need to regularly and personally inform the key personnel about supply chain priorities before the bottlenecks occur.



The repairables supply chain aims at a pool size and a repair turn-around-time that keeps at least one of each repairable type on the shelf ready for release at all times. This objective requires close scrutiny of item criticality to the user (to enable budget priority assessment for repair or acquisition of additional items in the pool) and the usage rate. The accountable Class Principal Logistic Support Manager needs to maintain visibility of the status of these high-value¹⁰ items as they have a direct impact on operational downtime if not available when needed, and must be managed closely where the demand for the item exceeds the available supply. This involves ongoing liaison with the Stock Item Owner to ensure those charged with the responsibility of purchasing or maintaining warehouse stock items have an understanding of the priorities. This will avoid situations where repairables in the warehouse are not fit-for-purpose due to being held until a threshold quantity for repair is reached.

¹⁰ In terms of cost or criticality to achieving and sustaining operational effect

PRINCIPLE 8: MANAGE BY TOTAL COST OF OWNERSHIP ACROSS THE LIFE CYCLE

Total cost of ownership over the whole life cycle involves a large number of line items of cost, including:

- materiel concept and requirements definition, capital acquisition and operation
- materiel engineering analysis possibly resulting in
- major and minor upgrades
- corrective and planned maintenance
- materiel spares inventory and stock replenishment
- assurance activities
- infrastructure development and upgrades
- data acquisition and maintenance
- administration
- personnel upkeep, education/training.

It is impossible to ‘manage’ every one of these line items across the logistic enterprise without making gross assumptions about shared resources and without employing an activity-based codification of all functions being performed. By looking at total cost as the sum of the cost of each phase of the life cycle, however, the problem is more manageable. The intent of **Principle 8** is to make it even easier.

The Pareto Principle

Vilfredo Pareto, an Italian economist, postulated in 1906 the general rule that 80% of effects come from 20% of the causes. This principle has been found to apply in almost all aspects of macro and micro economics.

Principle 8 employs the rule by postulating that 20% of all line items of the entity being measured will have an 80% direct impact on

the repeatability of operational effect, including readiness and preparedness. It is only necessary, therefore, to identify very closely what those 20% of cost-driver line items are at each phase of the life cycle and to then focus on managing that set only. One still has to account for the other 80% and continually seek savings, but it must not be closely 'managed', as there will be negligible return for the effort.

The cost of each phase of the life cycle cannot easily be bundled, since each class of ship and submarine arrives with a different level of maturity. For example, if a batch of ships are acquired as part of a foreign Navy's large production run, then the concept, requirements and design costs to the buyer will be lower compared to a home designed and built version. The operate-and-support phase of the life cycle includes upkeep, update, upgrade and management cost line items which will be largely the same (not in value, but in category) for all vessels regardless of age. The logistician's job is to determine which 20% of those lines will give 80% of the required repeatability of operational effect and how they can be intensively managed. It is not difficult to assume, and history supports the fact, that upkeep costs will normally dominate the combined update, upgrade and management costs, and that upkeep costs increase as the vessel ages.

Bear in mind, however, that the so-called 'bath-tub' curve of increased failures at the beginning and end of predicted life that is often applicable to individual equipment is not true for whole ships. It should be noted at

the outset that the predicted service lives of the structures and numerous equipments that combine to form the ship can be and most often are quite different, and some items that are more prone to effective intervention prior to failure than others. The bath-tub curve of early life failure and end-of-predicted-life failure is applicable to the individual, predicted service lives of the individual items but the high quality assurance requirements of military specifications generally sees fewer early-life failures . As is expected, the majority of equipment fails randomly through its predicted service life (and beyond that prediction), which drives the requirement for a good spares backup, some items being carried onboard and others ready for release to the ship when needed. The actual failure ‘curve’ for a ship through life is a slowly rising straight line. Logisticians must determine which cost lines represent the 20% that must be intensively managed. Spares are a good example of high cost items to stock and replenish, and which have a direct and very significant impact on repeatability of operational effect as discussed at **Principle 7**, but which are not traditionally managed intensively by engineers. This highlights the importance of close collaboration between engineers and supply chain staff in the logistics enterprise.

The principle of managing the total cost at each phase of the life cycle by intensively managing the top 20% of line items only fits neatly into the discussion about the selection of KPI at **Principle 3**. KPIs must cover this top 20% set. A performance framework can largely be driven by this set at each phase of the life cycle, noting that the top 20% will be different for each phase. The KPI clock runs 365 days a year, whether the asset is in design, build, or at sea.

PRINCIPLE 9: GENERATE A POSITIVE SEAWORTHINESS ASSURANCE CULTURE

The maritime logistics doctrine thus far has concentrated on a belief system of principles that together achieve the highest goal, the delivery of a repeatable operational effect. **Principle 9** broadens the scope to ensure that, in delivering the operational effect, the hazards and risks to its personnel are eliminated/minimised so far as is reasonably practicable and the hazards/risks to the environment in which it operates are eliminated/minimised so far as is reasonably practicable. These three aspects, operational effect, safety and environmental protection are embraced in the term 'seaworthiness'. The aim of **Principle 9** is to assure seaworthiness in all phases of the asset life cycle.



HMAS WESTRALIA

“The formal RAN configuration change process is circumvented at times, generally by well-intentioned personnel, and this can have a severe impact on safety.”

Conclusion No 148 of the Report of the Board of Inquiry into the fire in HMAS WESTRALIA

Report into the machinery space fire resulting in the loss of life of four crew members on 05 May 1998

The change involved the replacement of rigid steel fuel lines with flexible hoses to absorb vibration. The process was circumvented by the urgency of the need, the consequential non completion of the requisite change directive documentation, and the final error of fitting hoses which were not to Lloyds approved standards for the requirement.

The important message in this doctrine has been, and is, the sustainment of operational effect, because that is Navy's responsibility to the Australian people. Seaworthiness requires balanced consideration the safety of personnel and protection of the environment; nonetheless, the 'sustainment of operational effect', as the aim at the preface states, is the primary purpose of maritime logistics.

The word 'assure' means to pledge, or guarantee, that something will happen in the way it was meant to happen. In maritime logistics it means a system that guarantees the seaworthiness of the logistic enterprise at all phases of a ship or submarine's life cycle. This system is dedicated to identifying every risk and reducing it so far as reasonably practicable. It is called the Defence Seaworthiness Management System. A series of instructions that identify the risk and the acceptable means of compliance to mitigate it form the basis of the requirement. An organisation dedicated to assuring that the actions are occurring, and that they are satisfactorily mitigating the risk, has been established. It operates at three levels, the top being an independent authorised body with international auditing accreditation, the middle being an internal Navy body working to a seaworthiness assurance master plan, and the third being internal management audits specific to the workplace environment, such as a ship's engineering department and a ship's seaworthiness release plan.



Sea King Board of Inquiry

RAN Sea King helicopter N16-100 crashed on 02 April 2005 at Nias Island Indonesia resulting in the loss of the aircraft, the life of four crew, and five of the seven passengers during Operation Sumatra Assist.

“It was established by review of maintenance audits, technical investigations and maintenance safety incident reports that maintenance error and non-compliant maintenance practices were recurrent and existed at 817 Squadron well before the accident. The Inquiry identified that the non-compliant practices developed in response to high maintenance workload at 817 Squadron during periods of high tempo of operations in the years 2000-2004 that resulted from strategic and Government tasking.”

**Nias Island Sea King Board of Inquiry
Report September 2006**

Seaworthiness remains a shared responsibility and a duty, regardless of role. The seaworthiness culture is embedded in every decision made at every level in the logistic enterprise. Risk must be eliminated or an acceptable means of compliance found. This should not be an onerous obligation. It simply makes sense. Apply it as an absolutely normal code of practice and seek guidance if unsure about your knowledge, experience, confidence, competence, qualification, authority or judgement to make the right decision or perform the right action. Above all, Navy’s people must remain positive about the reason for the seaworthiness culture and each person’s part in meeting its intent.

PRINCIPLE 10: ACHIEVE GOOD STEWARDSHIP THROUGH CONTINUOUS IMPROVEMENT

Good stewardship means a constant work ethic and attitude that will leave your ship, submarine, aircraft or place of work in a better condition than when you arrived. It is achieved through continuous improvement.

This Chapter includes numerous examples of the ultimate effect of making a basic maintenance procedural error (e.g. Nias Sea King N16-100 split pin) or a change management procedural error (e.g. HMAS WESTRALIA non-compliant flexible hose fitting). At the higher management level, formal collaborative planning (described at **Principle 1**) up and down the decision chain between maintenance demand and seaworthy materiel delivery will do much to have the basics understood and managed accordingly. This is good stewardship combined with continuous improvement.

The first step to continuous improvement is getting the basics right. Do the right thing and do it right first time. If things do not make sense, then challenge the way we do things. If they do not meet Navy's requirements in a reasonable timeframe or at a reasonable cost, then look for the root causes and try to correct them. Logisticians must aim to achieve technical mastery of their business and to regularly review their processes and codes of practice with a view to achieving higher standards with less effort. Above all, if you see problems, fix them.



2

CHAPTER

MARITIME LOGISTICS DEFINED



MARITIME LOGISTICS DEFINED

KEY THEMES

Maritime logistics is the science and art of generating and sustaining Navy materiel capability with the emphasis on integration and synchronisation of engineering, maintenance and supply support functions.

A key role of the logistician in the maritime environment is to ensure the generation and sustainment of seaworthy materiel.

The generation and sustainment of seaworthy materiel is achieved through the integration of engineering support, maintenance support and supply support.

The objective of maritime engineering is to maximise the likelihood of maritime capability systems achieving, and continuing to achieve, the defined operational outcomes whilst making all reasonably practicable efforts to eliminate / minimise risks to the safety of personnel and the environment.

Maintenance of maritime capability systems is undertaken to provide seaworthy materiel through the maintenance of the baseline.

The objective of supply support in the maritime environment is to provide the prescribed materiel and services in the right quantities, in the right units of issue, at the right place, at the right time and with the right quality; and also sustain that support over time.

OVERVIEW

Maritime logistics involves a range of networks that extend beyond Navy to include commercial entities, coalition partners and host nations. A significant proportion of Navy's support is drawn from the capabilities of defence contractors. Navy has and will continue to have a reliance on sustainable systems and procedures supported by civilians and contractors. This relationship is symbiotic in nature; Navy trains uniformed personnel who are often employed after leaving the Navy by the commercial sector in the support of Navy capabilities.

Capability systems must be acquired with inherent design reliability and supportability as key considerations and Seaworthiness as the outcome. The maritime logistic challenge is to ensure endurance, while maritime commanders must place a high priority on the stewardship of capability systems in their charge to enable this endurance. This requirement equally applies to all of Navy's people.

This chapter explains:

- terminology used throughout the document
- the principles of logistics and their application within the maritime environment
- how maritime logistics underpins Sea Power and maritime operational concepts.

KEY TERMINOLOGY

There is a range of terminology used throughout this doctrine that is in common usage in a tri-Service and Joint operational context. Without straying from Defence doctrinal definitions, it is necessary to precisely define some of these terms so that there is no misunderstanding of their usage in the maritime context. The key terminology used throughout this doctrine includes:

- seaworthiness
- endurance
- maritime materiel logistics
- engineering
- maintenance
- supply.



SEAWORTHINESS

Seaworthy

A mission system is seaworthy if its operation in accordance with its statement of operating intent (SOI) maximises the likelihood of achieving, and continuing to achieve, the defined operational outcomes whilst making all reasonably practicable efforts to eliminate / minimise risks to the safety of personnel and the general public and the environment. Whether a mission system is seaworthy is a judgement as to whether the state of a mission system's materiel, personnel, logistic, organisational and informational aspects are sufficient to achieve this outcome.

Seaworthiness

The Seaworthiness of a mission system is judgement of the ability of the Unit or Class to be supported in becoming and thence remaining seaworthy for the roles identified in the SOI, given the stated configuration and environment for operations utilising the services of afloat (organic) and ashore support systems. It is the measure of the ability of the support systems to sustain the required materiel state / condition, to maintain the required level of supplies, to retain the required personnel (in the required numbers and competencies), to preserve the integrity of data and documentation, and continue to manage activities so that a Unit or Class can remain Seaworthy over the life-of-type.

This publication focuses on how logistic organisations and staff can ensure Seaworthiness.

ENDURANCE

Endurance is a key concept for both the development of maritime capabilities and the support requirements of those capabilities during their life. In the maritime environment, endurance is the time a maritime asset or task group can continue operating without external supplies and support. The endurance of warships determines their ability to persist in theatre over extended periods and consists of:

- the endurance of people, enhanced through effective leadership, the provision of good food, water, accommodation ('hotel services'), a healthy work environment and adequate rest and recreation facilities
- the endurance of materiel, enhanced through inherent design reliability and availability at the capability acquisition stage and sustained through life with the support of an effective maritime logistics system. This includes access to supplies including victuals, petrol, oil and lubricants (POL) holdings, spares holdings and the maintenance of the materiel system.

To a greater or lesser degree, all warships are self-sufficient and can remain independent for periods of weeks or even months. Ships can operate individually or in task groups, and are required to be logistically self-sufficient for the initial periods of a deployment. In addition, ships may have to operate independently of continuous resupply channels and often with interrupted communication links with external support infrastructure.

The amount of support that can be generated at sea is primarily driven by the Class maintenance support philosophy translated as endurance policy. Equipment endurance is further influenced by the 'support triad' of the:

- technical mastery to operate and sustain the materiel in accordance with the SOI
- determination of materiel requirements including fuel, victuals, stores and ammunition consumption rates and resupply periodicity

- considerations such as:
 - safe storage
 - organic repair capabilities
 - time available, space limitations, tools and test equipment availability and/or operational situation.

Navy ships range in size from minor war vessels to major fleet units; all need the same range of support services to deliver the prescribed operational effect delivered through the support system constituent capabilities, described in chapter 3, and consisting of:

- operational support
- engineering support
- maintenance support
- supply support
- training support.

Some ships require a greater degree of external assistance than others. Accordingly, Navy operates its vessels with support concepts tailored to the size and on-board logistic support capacity of the vessel (typically by Class). Endurance of warships may be extended when they operate as part of a Task Group and through support multipliers such as replenishment vessels, aviation assets and the configuration of the Task Group (enabling the sharing of support items through the Materiel Control Officer (MATCONOFF) and urgent materiel screenings (UMS)).

Endurance is a key consideration during the determination of the needs and requirements phases of maritime capability development. It influences

ship design of fuel holdings, ammunition magazines, storerooms and refrigeration. Endurance is a key driver of a warship's operating concept (particularly the technical skills of the personnel), the length and type of mission, the underway replenishment requirement and shore based support infrastructure. Endurance is also a key factor in the design of the support system. Ships that are expected to endure for long periods away from the national support base (NSB) typically need to factor in support from multinational partners or commercial vendors in the regions they operate.

MARITIME LOGISTICS

Maritime logistics is the science and art of generating and sustaining Navy materiel capability with the emphasis on integration and synchronisation of engineering, maintenance and supply support functions. Maritime logistics ensures that Navy capability systems:

- are designed-for-support from the earliest concept stages of the acquisition process, by including this need in the operational concept and functional requirements specifications
- provide continuous repeatability of operational effect through qualities of high inherent reliability, maintainability, accessibility, availability, useability, supportability and liveability
- are realised and sustained in a cost effective manner through logistic engineering analysis and ongoing assessment of reliability, availability and maintainability
- are supported during the in-service phase of the capability life cycle through the provision of operating, engineering, maintenance, supply and training support.

To understand maritime logistics, it is necessary to consider the inter-relationship between engineering, maintenance and supply and how engineering decisions and logistic engineering techniques fundamentally shape the subsequent supportability of capability systems. Figure 2.1 depicts this relationship and underpins the discussion throughout this doctrine.

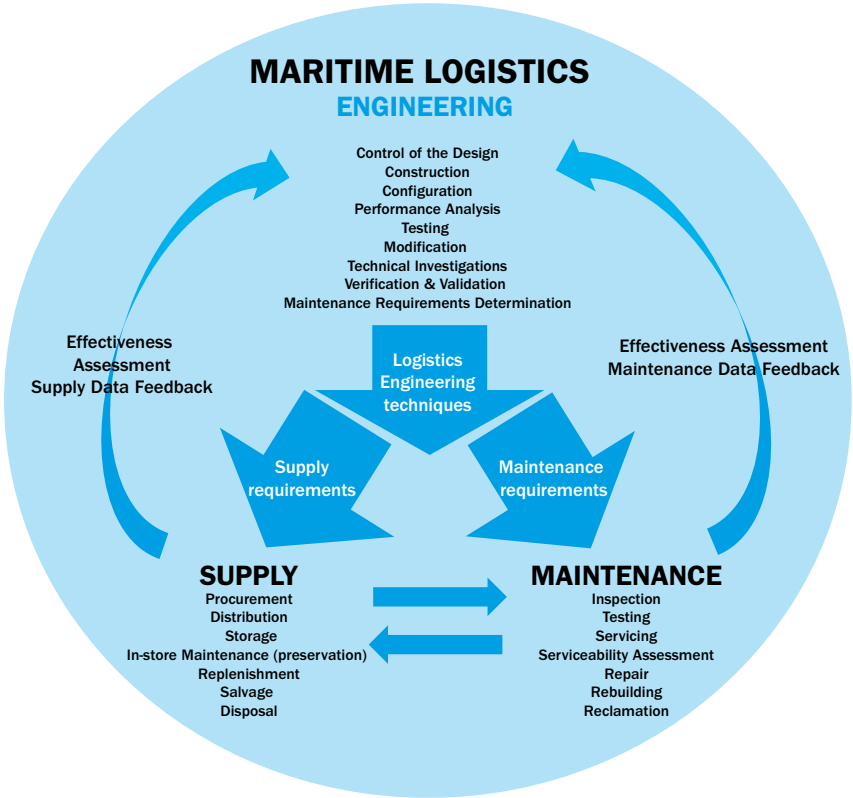


Figure 2.1: The relationship between the engineering, maintenance and supply functions

DEFENCE ENGINEERING

Engineering is the application of technical analysis and decision making processes for materiel solutions intended to safely satisfy user requirements. As such, sound engineering is fundamental to ensuring that materiel is acquired and operated with seaworthiness as the key driver.

Engineering involves the design, construction, configuration, performance, maintenance requirements, testing and modification of a product. Engineering activities also include the conduct of technical investigations, reviews, verification and validation and assessment of materiel.

Engineering consists of the:

- development of standards and specifications
- the development and subsequent verification and validation of designs as meeting those standards
- the acceptance and certification for use of the item described by the approved design (ie. the product meets the design definition).

Engineering is an essential constituent in the preservation of maritime assets including any enhancements to the asset throughout its service life. Maritime capability systems employ modern technology to achieve combat advantage. In modern naval warfare the ability of the logistics organisation to repair faster and sustain longer than the enemy is essential. Navy places great value in the quality of its engineering support, since it is instrumental to the seaworthiness of maritime materiel ensuring the gaining of the combat 'edge' over an adversary.

Engineering and maintenance are not synonymous; engineering adds value through the intellectual effort to design or modify a system or equipment, document, procedure (including maintenance procedures), standard, instruction, drawing, training, or spares allowance. Engineering completes the analysis of condition assessments, maintenance effectiveness reviews and proposes solutions where warranted. Maintenance applies

the engineering analysis. It sustains equipment through condition measurement, servicing, preventive maintenance, and restores failed or potentially failing (subject to condition assessment) equipment to standard operating parameters through corrective maintenance.

Simply put; engineering, through the analysis of data, designs, constructs and modifies materiel making changes to the baseline; maintenance retains or restores materiel to its prescribed condition specified in the design through engineering techniques.

MARITIME ENGINEERING

The objective of maritime engineering is to maximise the likelihood of maritime capability systems achieving, and continuing to achieve, the defined operational outcomes whilst making all reasonably practicable efforts to eliminate / minimise risks to the safety of personnel and the environment.

Materiel support must be addressed through engineering processes during all stages of the capability life cycle to ensure cost effectiveness of the capability is maintained; this requirement is particularly important in the early stages of the cycle, where design for supportability must be inherent from the beginning if materiel is to be affordably maintained in a seaworthy condition throughout its life. Figure 2.2 illustrates the extent to which the engineering objective can be met at the various phases of the life cycle.

Engineering support

Engineering support consists of engineering solutions aimed at whole-of-ship materiel Seaworthiness, ship system safety, effectiveness and supportability through system integration and ongoing modification, whilst maintaining technical integrity and configuration of materiel. Engineering support includes the concepts and requirements for both the mission system and significant support system components. Engineering support is underpinned by a range of engineering disciplines, and in the context of this doctrine systems engineering and logistics engineering are core to the provision of through-life capability support.

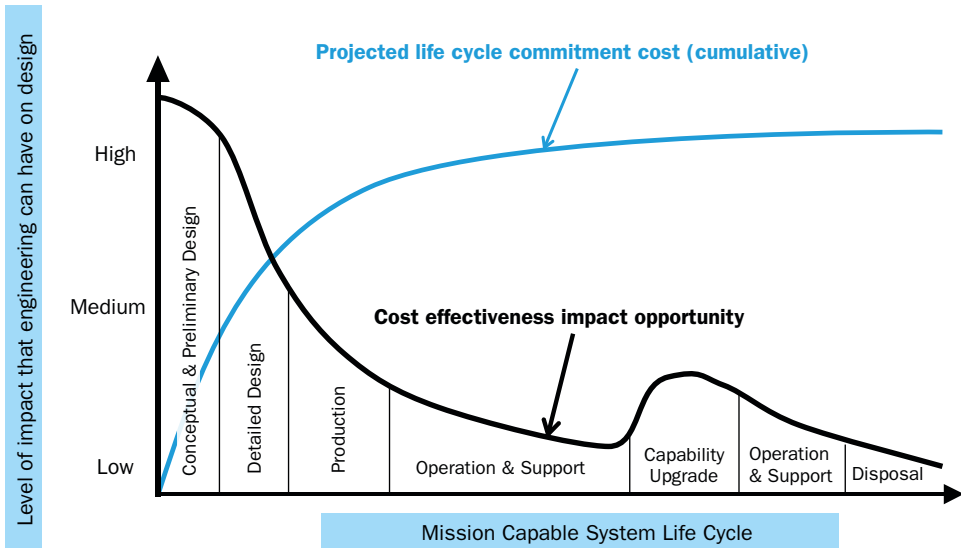


Figure 2.2: Engineering potential to influence the remaining capability life cycle

Systems engineering

Navy seeks to satisfy its engineering philosophy through systems engineering methodologies, which commences during the identification of the need for a capability and extends through the early definition of system requirements, the development of technical performance measures and performance-based logistics factors, functional analysis and allocation, design optimisation, construction, test and evaluation plans, and system validation through-life until disposal. In practise, the whole of life philosophy consists of:

- **Capability realisation phase.** Systems engineering involves a series of predetermined processes conducted over the course of the systems design, development, construction, integration and test stages to ensure that requirements are properly integrated into the end product.

- **Capability operations support phase (in-service and disposal).**

Systems engineering is also applied in the operations support phase to ensure modifications to the materiel system are made in a controlled manner compliant with authorised requirements.

Logistics engineering

Systems engineering is supported by a specialised sub-set of processes known as logistics engineering. The resources required to provide capability support must meet warfighting needs and be minimised to ensure long-term affordable materiel readiness. Logistics engineering seeks to ensure effective and efficient logistics support and that capability systems are designed, maintained, and modified to continuously reduce the demand on support systems.

Logistics engineering is a whole-of-life discipline that focuses on ensuring materiel supportability, reliability, availability, maintainability and longevity at the lowest life cycle cost. For example, the Navy may decide to acquire a capability system with lower acquisition costs; however, often cheaper systems are less reliable and supportable, and may have higher long term sustainment costs. Conversely, selection and early acquisition of a highly reliable but very expensive capability system may result in reduced whole-of-life costs of the system due to its low maintenance and supply support costs. Logisticians must complete a detailed analysis of the cost versus effectiveness of a capability system for its whole life and ensure that any acquisition decisions are made with a detailed understanding of the full life costs.

Logistics engineering must be considered in all phases of the capability life cycle; that is, logistics must be considered as an inherent element in the systems design process, as it constitutes a major activity in the construction and/or production of a system and its components, and the subsequent support during its operational use. It is desirable that system design engineers and sub-specialist logistic engineers work in complete partnership and collaboration, as each adds a dimension that considers



both design reliability and logistic supportability and consequential endurance of the capability system.

Logistics engineering requires a total system perspective approach to ensure the seaworthiness of materiel and includes all the activities associated with the:

- initial definition of system support concepts, philosophies and requirements
- development of logistics support criteria as an input to the design of not only those mission-related elements of the system but also the support requirements
- ongoing evaluation of alternative system support mechanisms through trade-off studies, support system design optimisation, and formal design review
- determination and acquisition of the resource requirements for support based on a given design configuration, including the integrated logistic support (ILS) elements
- ongoing assessment of the effectiveness and efficiency of the support system with the objective of continuous improvement of support through the iterative process of measurement, evaluation, and recommendations for enhancement.

Logistics engineering is enabled by a range of analyses, the principle one being the logistic support analysis (LSA). The LSA process provides a foundation for the integrated logistics support program by generating source data and plans, which help determine other ILS elements. LSA is about questioning the level of maintenance, training, sparing, etc of a capability system to determine if it can be done better or more efficiently. The LSA process model can use several analysis techniques including:

- use study to determine operational needs

-
- top-down failure modes and effects analysis (FMEA) to determine critical systems
 - bottom-up failure modes, effects and criticality analysis (FMECA) to determine critical items within critical systems
 - level of repair analysis (LORA)
 - reliability centred maintenance (RCM)
 - engineering support task analysis
 - supply support task analysis (SSTA)
 - maintenance support task analysis (MSTA)
 - operating support task analysis
 - training support task analysis
 - failure reporting, analysis, and corrective action (FRACA)
 - data collection, analysis, and corrective action (DCACA).

Logistic engineering also determines the:

- supply support requirements
- maintenance support requirements
- personnel support requirements including operating and training needs
- facilities, support infrastructure and equipment, and test equipment requirements
- information management requirements, with the key issue for Navy being LIS that operate in all states of readiness whether deployed or alongside, and during degraded states of LIS functionality (eg a communication interrupted environment).

MAINTENANCE

Maintenance involves the application of skills, knowledge and actions necessary to retain equipment in its approved design configuration by the application of a maintenance philosophy, developed in concert with the equipment design, operating concept and operating environment. Maintenance consists of all actions taken to retain equipment in, or to restore it to, the minimum level of conformance with the reference set of materiel standards, using the required codes of practice (CoP) applicable to the product, its support products and processes. It includes inspection, testing, servicing, repair, rebuilding and reclamation. Maintenance ensures that materiel is maintained in a condition that enables it to perform reliably in its intended environment and to function as it was designed. It does not include modification or upgrade from the approved product baseline (PBL).

Maintenance objective

Maintenance of maritime capability systems is undertaken to provide seaworthy materiel through the maintenance of the baseline. Maintenance is conducted for four primary reasons:

- **Statutory maintenance** – that required by law
- **Navy regulatory maintenance** – that to deliver materiel seaworthiness
- **Asset preservation** – that to deliver seaworthy materiel for its whole life of type, and
- **Grooming** – that to be mission ready.

The primary objective of maritime maintenance is to achieve:

- an optimum balance between asset availability and sustainment to meet preparedness requirements without compromising materiel seaworthiness
- optimum operational availability during a contingency, realising that safety, redundancy, mission margins and mission worthiness may be varied in a controlled, risk-based, manner.

Maintenance attempts to prevent deterioration of designed reliability levels. As maintenance cannot prevent random malfunctions, Navy must continue to reduce the likelihood of failures through a comprehensive system of maintenance types, namely preventive, or planned, maintenance (PM), corrective maintenance (CM) and inactive equipment maintenance (IEM). The requirement is for targeted maintenance that focuses on delivering the most appropriate maintenance when and where it is needed.

Maintenance philosophy

The maritime maintenance philosophy is to balance organic maintenance capabilities against demands to maximise endurance through materiel availability. The incorporation of maintainability design features, such as modular maintenance assemblies, good access and credible removal routes, enables defective components to be removed and the capability system quickly returned to a serviceable state. Defective components are returned through the reverse supply chain for more extensive testing and repair.



The challenge for Navy is to ensure that the materiel design provides the required levels of reliability and maintainability, whilst safeguarding system endurance within the limitations of the support system's resources (training, personnel, technical data, spares, and support and test equipment). This challenge is met through RCM analysis and subsequent condition based maintenance (CBM) practices at the front and centre of Navy maintenance philosophy.

Ship endurance and availability during operations (on-task) can be maximised by increasing the capacity of organic maintenance. It is, however, impractical to embed the capacity to conduct all maintenance within the ship. As a result there are two complementary goals:

- the total preventive maintenance requirement should be minimised through a combination of acquired asset high inherent reliability of design and support philosophy (see Chapter 1 Principle 2)
- the organic-level resource component of that maintenance requirement should be maximised.

Maintenance resources

Maintenance activities vary from small, simple tasks requiring the minimum of equipment, such as the replacement of filters, to large, complex tasks requiring extensive tooling and infrastructure, such as the major servicing or refit of a ship. The duration of maintenance also varies from a short task performed in minutes to an activity that may take many months to complete. Within this continuum exists a vast range of maintenance activities that may be undertaken by various organisations with differing levels of skilled personnel, special tools, repair parts, facilities and technical data. For new capability systems, LORA and maintenance task analysis (MTA) are the principal analyses that determine the resources required for a maintenance task.

Navy has two levels of maintenance delivery resource, namely organic maintenance and external maintenance. Organic maintenance is generally classed as being performed within the operational environment of the

vessel, by crew members of the ship without external assistance. It may range from simple to technically demanding tasks, required to maintain the platform's capability. External maintenance is generally that maintenance beyond the capacity or competence of the support equipment and/or ship's personnel, and is undertaken by uniformed support personnel, and government civilian personnel or commercial providers. External maintenance assistance relies heavily on industry support, which can provide the deep skills, expertise and capacity to perform tasks beyond the organic capacity.

Whereas 'organic' and 'external' maintenance terms are convenient discriminators for defining resource requirements, there is no policy that prevents organic maintenance being performed by external resources, nor external maintenance being performed by organic resources. Organic resources are authorised and must perform all levels of maintenance at any time when needed to maintain or restore operational effect.

Maintenance Support

Maintenance support consists of the planning and conduct of preventive, corrective and inactive equipment maintenance. Preventive maintenance is largely condition-based maintenance and routine servicing derived from RCM analysis. It includes vibration analysis, oil sampling, surveys, investigations and inspections aimed at determining non-conformances (see Chapter 1 Principle 3) that can be corrected through deeper levels of preventive or corrective maintenance. This aims at sustaining the currently approved configuration baseline. The continual feedback of maintenance data enables the constant analysis and readjustment of the maintenance support requirements.

The relationship between maintenance and engineering

Maintenance and engineering are mutually supporting but not interchangeable. Engineering support provides the systems analysis that is then able to determine the maintenance support requirements and the completion of maintenance. The anticipated maintenance requirements including levels, routines and periodicity are determined primarily through

the LSA, particularly through, LORA, MSTA, FMECA and, more generally, RCM. Engineering support determines the maintenance philosophies, data and documentation, and schedules required for maintenance planning during the capability life cycle including:

- materiel requirement specifications (MRS) found in the maritime materiel body of knowledge (MMBoK)
- technical data (in applicable electronic formats)
- the class maintenance plans and ship system technical maintenance plans
- preventive and corrective maintenance standard activities (SA), including the inspection and actions required, and the frequency of occurrence (periodicity), all originally sourced from original equipment manufacturer (OEM) data and further refined using RCM analysis.

The relationship between maintenance and supply

Maintenance and supply also have a symbiotic relationship. Maintenance typically requires the provision of repair parts, materials, supporting tools, test equipment, suitable working environment and data to maintain or restore a capability system to the required condition. Additionally, repairable items are usually restored to a serviceable condition through maintenance actions that may include repair, rebuilding, inspection and certification. The integration of LIS that provide the interface within and between the maintenance and supply functions, and support the processes and work flows, is essential to the optimisation of this relationship.

SUPPLY

Logistics engineering determines, amongst other things, the type and quantity of stores required. The supply support function then manages their subsequent procurement, distribution, storage, in-store maintenance (preservation), replenishment, salvage and disposal. The supply function identifies and acquires the prescribed item, and places it in the right location at the appropriate time and in the right condition. Supply has two phases:

- **Producer phase.** That phase of military supply that extends from requirements determination and procurement schedules, to acceptance of finished supplies.
- **Consumer phase.** That phase of military supply that extends from receipt of finished supplies through issue for use, consumption, preservation, return, replenishment or disposal.



Supply objective

The objective of supply support in the maritime environment is to provide the prescribed materiel and services in the right quantities, in the right units of issue, at the right place, at the right time and with the right quality; and also sustain that support over time. Given the cost involved in supporting maritime capabilities, economy will always be a significant factor in supply support planning. However, whilst the importance of economy must be recognised, decisions must ultimately be made on the basis of preparedness to deliver effective supply support.

Supply philosophy

The maritime supply philosophy is for ships to be able to sustain themselves, depending on their Class, for set durations (endurance). Ships must be designed with the ability to hold and manage sufficient stores for the planned mission duration, as per stated operating concepts and performance specifications. Navy aims to maintain an endurance load of the full range of the various classes of supplies including provisions, fuel, ammunition and spares onboard to ensure readiness, flexibility, reach, poise, persistence and resilience.

Supply support

Supply support ranges from procurement, through warehousing, packaging and handling, in-store maintenance and distribution and are determined primarily through the LSA. The continual feedback of supply related data such as demand satisfaction enables the constant analysis and readjustment of the supply support requirements.

The relationship between supply and engineering

Supply and engineering requirements are inter-reliant; logistics engineering determines the supply support requirements including:

- materiel requirements determination
- assembly parts lists

- shipboard allowances including approved alternative and substitute parts
- warehouse/in-store survey and maintenance requirements
- calibration requirements of tools, test equipment and supply items
- supply chain data.

The relationship between supply and maintenance

Supply and maintenance are also intrinsically linked. The supply support function provides the spares, tools and material, to enable repairs and maintenance. In turn, the maintenance support function returns the repairable items (RI) to supply organisations for them to manage the packaging, transport and handling to and from maintenance agencies and all other associated distribution and warehousing prior to the RI's return into operational service. Support system decisions on mission system maintenance are often permanently fixed during the acquisition process, and must be reflected in corresponding maintenance, supply and distribution capabilities at all levels. Maintenance and supply decisions during the design of the support system have long-term cost and effectiveness implications.

Supply chain operations

Supply chain operations involve the process of planning, implementing and controlling the efficient and effective distribution and storage of materiel, services and related information from point of origin to point of consumption. In the maritime context, the supply chain links the source of materiel through air and sea lines of communication (ALOC/SLOC) and nodes such as ports and airfields to task force, task group or individual vessel, and continues with the return of repairable items for maintenance and then return to store serviceable for future despatch. The overriding principle for Navy in regards to the supply chain is to effect the secure delivery of required materiel and support to our ships anywhere in the world, with standardised data interaction and the balance between urgency of need and cost.

The supply chain includes warehousing, distribution, repair and overhaul, and disposal of materiel, synonymous with inventory control. Supply chain management starts with the provisioning organisation, whose job it is to determine what is required, the quantities to be procured, and any limitations that may constrain the use of the materiel once it is received from industry. Supply chain management continues to the unit that consumes/uses the materiel, and continues its cycle with the return of repairable items.

The supply chain describes the distribution system linking materiel holdings to the deployed forces. In the maritime environment there are “supply pulses” of materiel and support from multiple sources including:

- materiel demanded from ADF managed stocks, which include in-service support trusted commercial agents, including:
 - rotatable items returned to stock once repaired
 - items harvested from equipment that is beyond economical repair and returned to stock
- materiel obtained from or exchanged with multinational forces
- materiel demanded directly from the manufacturer
- materiel managed by a contractor
- materiel sourced and procured from commercial entities in theatre.

Responsibilities for materiel within the supply chain rest with:

- capability managers who determine the requirement for materiel
- the sustainment agency that procures the majority of materiel
- the supply chain management agency that manages the distribution of materiel along the supply chain to the Agreed Point

- the Joint Task Force Commander (Comd JTF) who manages the materiel forward of the Agreed Point with the assistance of a Logistic Support Element (LSE)
- the Task Group Logistic Coordinator (TGLC), or the LSE in the case of single unit, who manages the distribution to the maritime element Naval Task Group or unit that consumes or uses the materiel
- commercial support providers and shipping agents in non-RAN ports (for example through standing offers) and ship's interface (MLO, ML-SC).

The supply chain as it relates to maritime Supply Support is depicted in Figure 2.3.

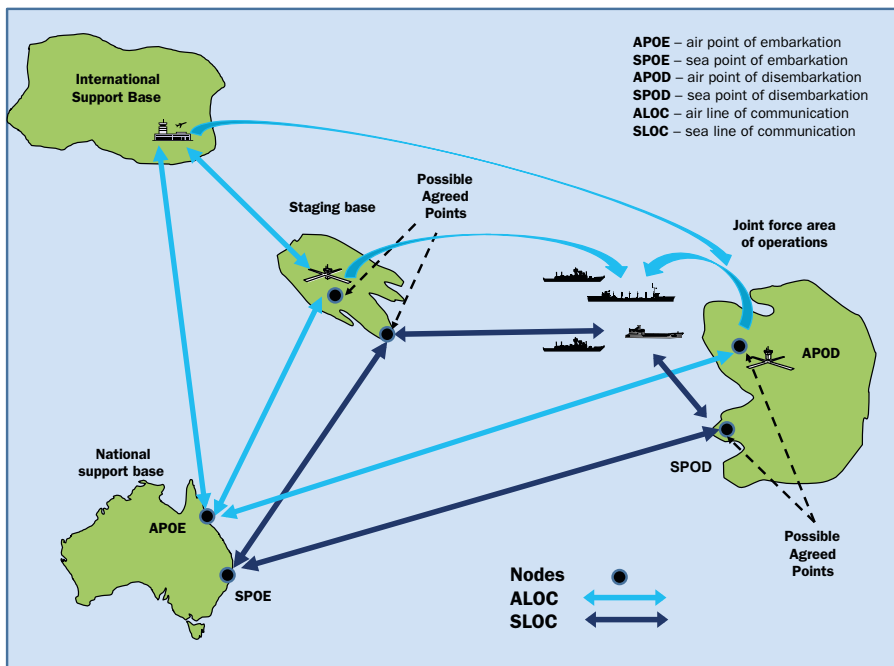


Figure 2.3: Supply chains to a naval task group

KEY SUPPORTING CONCEPTS

There are a range of underpinning supporting concepts that enable maritime logistics including:

- reliability
- configuration management
- parent navy
- commonality

Reliability

Reliability describes the ability of a system or component to function under stated conditions for a specified period of time. Reliability emphasises dependability in the life cycle management of and cost-effectiveness of capability systems. Navy must ensure that it acquires reliable systems as a key determinant. It is of little use to have the most up-to-date capability if it proves to be inherently unreliable; thus results in an inability to deliver the required operational effect as well as downstream costs of attempting to rectify the causes of the systems unreliability.

Configuration management

Configuration Management is a technical discipline applied to manage the evolving design of materiel and associated documentation and software. Configuration Management and its linkages to materiel systems management, systems engineering, and ILS management provide the foundation for the cost effective acquisition of materiel, its safe operation and sustainment through life, and the effective archiving of data at disposal.

The Configuration Management discipline encompasses identifying and recording the physical and functional characteristics of an item, and periodically auditing and verifying those characteristics; recording the status of the configuration of an item; and controlling changes to an item, its

documentation and data. The principle of Configuration Management is to ensure mission system worthiness and safety. Configuration Management:

- **identifies** configuration records for **the capability system** in the form of approved baselines including the functional baseline (FBL), allocated baseline (ABL) – the design baseline and product baseline (PBL) - as delivered and accepted
- **controls engineering change** to the system by imposing processes that register approved temporary (termed ‘variations’) and permanent changes to the FBL, ABL and PBL through life
- **provides configuration status reports** on each of the FBL, ABL and PBL at any point in the capability system life cycle
- **audits the Capability System** to ensure that the physical product is congruent with its configuration records.

Importantly, for a capability to remain seaworthy, the configuration baseline must be controlled and changes to the baseline only undertaken following established processes and procedures. For materiel, the important aspect is that control and changing the baseline can only occur as a result of logistic engineering processes. Once these changes have been executed, supply and maintenance processes ensure that the baseline is maintained. Where the baseline requires a change resulting from feedback, organisational change or an investigation, logistic engineering techniques are used to determine the changes that are required and the new baseline of the capability.

Parent Navy

Acquiring vessels that have a parent Navy support structure in place is an acquisition decision that can have significant savings benefits, the key being that a significant component of the engineering and configuration management of the vessel is undertaken by the parent Navy. Caution must be exercised and compromises properly researched where operational profiles and design and maintenance philosophies of

the parent Navy differ markedly from the acquiring Navy. Nonetheless, Parent Navy costs still have to be managed properly; reaping the benefits in acquisition and then not funding the ongoing sustainment of the relationship with and support to the Parent Navy will result in unacceptable downstream costs. Consideration must be given to the need for ongoing agreements with parent Navies and Defence Forces to continue to effectively manage and influence major systems through life. The continuing data exchange, ability to influence design changes and configuration management, training and maintenance, and operating initiatives can only be properly coordinated through embedding staff with the parent Navy and the support of and involvement in user groups, working groups and forums.

Commonality

Matériel commonality must be a key consideration in design acquisition selection. Commonality can simplify equipment procurement, reduce life cycle costs and minimise the risk of diminishing manufacturing sources and material shortages (DMSMS). Commonality can be achieved through procuring platforms that are used by coalition partners, reducing the number of different items in the Navy's inventory through the selection and use of common matériel solutions, and the development and use of common standards to govern matériel development. Reducing the number of systems, sub-systems and/or components also offers opportunity to reduce the cost of ownership in terms of inventory investment, warehousing, contracted support arrangements, training systems and facilities. In the case of MOTS/COTS acquisition strategies commonality considerations must be balanced against capability requirements and the practicality of altering existing designs.



3

CHAPTER

SUPPORT CONCEPTS



SUPPORT CONCEPTS

KEY THEMES

Military capability is the sum of force structure and preparedness. The difficulty for logisticians and engineers is determining the sustainment requirements of the preparedness equation.

Maritime capabilities must be acquired with the application of integrated logistic support (ILS) at the forefront of all decisions and the realisation of the support system constituent capabilities before the capability is accepted into service.

CAPABILITY

Capability is the power to achieve a desired operational effect, in a nominated environment, within a specified time and to sustain that effect for a designated period. Capability consists of both:

- **Mission system** – the element of the capability that directly performs the operational function, which includes platforms, distributed systems and discrete systems, that integrate into other mission systems
- **Support system** – the organisation of hardware, software, materiel, facilities, personnel, processes and data required to enable the mission system to be effectively operated and supported.

Components of military capability

Military capability can be considered as the sum of force structure and preparedness. The establishment of effective military capability involves the development of an optimum force structure for the future and the maintenance of appropriate levels of preparedness of the Joint Force-in-Being (JFIB).

Figure 5.1 depicts the force structure and preparedness relationships to capability.

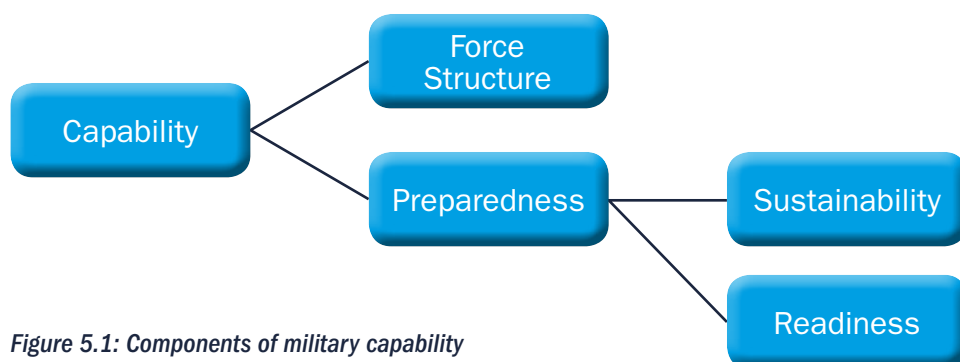


Figure 5.1: Components of military capability

Force structure

In the maritime context, force structure refers to the type of force required, including the organisation and composition of maritime elements necessary to meet capability requirements. The maritime force structure is determined by the tasks required by government and the resources allocated, of which support requirements and resources are significant components.

Force structure consists of:

- **Organisations** which include the physical elements and their roles, number, location, and command and control (C2) arrangements.
- **Composition** consists of the maritime assets (including warships and aircraft) and support systems, personnel, and facilities assigned.

Maritime logistics is a key force structure consideration, with the organisation and composition of the overall force defining the requirement for maritime logistics elements.

A significant determinant of naval operations is the requirement to conduct operations as a member of a task group, task force or combined fleet operation. Navy, in particular, is driven by the need to be interoperable within larger coalition naval forces where the provision of support is predicated in standard forms, processes, techniques and even types of equipment that are vital to sustainment. The operational support capability is a force multiplier in maintaining the endurance of the operation.

Preparedness

Preparedness is the sustainable capacity of Defence to deliver a prepared force, able to accomplish directed tasks and provide contributions to Government, for emerging issues and events that affect Australia's national interests. Preparedness seeks to measure how ready and how sustainable maritime forces are to undertake operations. This depends upon the organisational readiness of a ship and, in concert, the supporting elements. Preparedness is further defined as the combined outcome of readiness and sustainment.

- **Readiness.** Readiness denotes the ability of a ship or maritime element to be committed to operations within a specified time. Readiness measures the availability and proficiency of personnel and serviceability of equipment, facilities and the stockholdings of necessary supplies. Particular emphasis is placed on the availability of a warship for a specific mission and role within a designated time, with endurance a key determinant.
- **Sustainment.** Sustainment refers to the support systems required to maintain operations over an extended period until successful accomplishment of the mission. Sustainment includes the operating support, engineering, maintenance, supplies, training effort and

other ILS deliverables¹¹ required to prepare for operations. It also includes the continuation of these activities during redeployment and reconstitution/regeneration, to ensure capabilities are ready for the next task. Sustainment is largely enabled by an agreement or understanding (currently the Materiel Sustainment Agreement (MSA)) between Navy and the sustainment organisation (primarily through platform/system specific contractors) that, along with Navy's organic sustainment efforts, defines the long term outputs of a capability.

The sustainment challenge

A key challenge of the preparedness equation is sustainment. Readiness of a maritime capability is a scheduled, functional activity with clear measurable outcomes. The amount of resources required to support readiness can be determined in advance because the outcome - the

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¹¹ ILS is described later in Chapter 3



operational readiness of a warship for instance - is largely known; nonetheless, certain materiel such as ordnance usage may vary significantly from virtually nil to complete consumption requiring a full re-issue of the armament warrant and conceivably replacement of gun barrels at forward operating bases.

The success or otherwise of sustainment resides with the capacity of logistic staff to assess requirements with sufficient precision to strike the balance between the consequence of sustainment shortfalls and the cost of being over prepared, in terms of time, personnel hours, materiel and finances. Maritime support is influenced by the need to constantly reform the provision of support to achieve optimal and cost effective support arrangements and systems.

To determine the amount of resources required to operationally sustain a warship throughout its life poses a number of sustainment challenges. Ships typically have multiple missions, roles or tasks. Ships may sail for one mission, but need to be prepared for the full range of missions to allow flexibility to be re-tasked as required which, in turn, has a bearing on stores load outs, weapons load outs, personnel etc. Other challenges include:

- system re-configuration to meet a new role
- predicting the usage of supplies such as ordnance, fuel and victuals
- harsh environmental conditions (eg dust, heat, cold, bio-fouling or sea state)
- rapid changes to operational tempo
- hostile and uncertain environments
- varying activity levels
- remoteness from the home port or other support bases
- determination of likely battle damage.

SUPPORT

Types of support

Support consists of the organisation of hardware, software, materiel, facilities, personnel, processes and data needed to enable engineering, maintenance and supply services to be competently provided for the capability system. The Navy conducts support on two levels:

- **Organic support.** Organic support consists of those support tasks performed within ships and units, by ships' and unit personnel, and without external assistance. It may range from simple to technically demanding tasks, required to maintain the ships' or unit's capability.
- **External support.** External support consists of those tasks that may be beyond the capacity or competence of ships' or unit personnel, and may be undertaken by uniformed personnel or commercial providers, with the deep skills, expertise and capacity to perform those tasks. External support relies heavily on industry support. Historically, navies have a larger civilian/commercial support footprint than the other Services. A skilled and capable maritime support industry is a significant support force multiplier.

Personnel and health support are also critical to Navy to meet preparedness and readiness requirements.

Capability support requirements

Capability systems must be acquired with supportability as a key outcome. It is essential that Navy logistics and engineering staff influence the design and acquisition of future maritime capabilities required to meet operational requirements, with supportability as a key consideration across a capability's life cycle.

There are three parallel approaches used to design and manage capability mission and support systems:

- fundamental inputs into capability (FIC) – capability focused outcomes
- ILS - logistics resource outcomes
- support system constituent capabilities (SSCC) - service delivery outcomes.

FUNDAMENTAL INPUTS TO CAPABILITY

The FIC construct is the standard means for consideration of what inputs are required to generate capability. The FIC are used to ensure that all aspects of the capability system are considered during the needs, requirements and acquisition phases of the capability life cycle. In the maritime domain, the FIC considerations include:

- **Personnel.** Capability development proposals must clearly define what workforce will be required, when and where they will be needed, and with what competencies and skill sets.
- **Organisation.** Maritime organisations require a balance of personnel competencies and structure to accomplish maritime tasks.
- **Training.** Ships undertake collective training, validated against the preparedness requirements for operations.
- **Major systems.** Major systems include significant platforms and operating systems designed to enhance Navy's ability to project military power. These systems are not just ships and other vessels but include major systems such as weapons, power generation, surveillance and propulsion systems.
- **Supplies.** Supplies must be available within readiness notice to achieve the operational viability period (OVP) and ongoing sustainment of tasks required by the operational preparedness requirement.
- **Facilities and training areas.** Facilities include buildings, training areas, naval base support areas and associated through-life maintenance and utilities necessary to support maritime capabilities, both within the national support base and at deployed locations. Maritime facilities

include ranges, training facilities, bridge simulators, workshops, dry docks, and contractor test facilities.

- **Support.** The support FIC is a key FIC for logisticians to consider. Support is defined as the infrastructure and services within the national support base within Australia and offshore which are integral to the maintenance of Defence effort. This includes infrastructure, maintenance, logistics engineering, training, and contractor support, along with the latest configured data; these components are all integral to the sustainment of the capability both nationally and internationally.
- **Command and management.** Command and management includes the responsibilities, command and control mechanisms, doctrine, policy, processes and procedures to enhance the effectiveness of maritime forces and their associated support systems.
- **Industry.** Considers the industrial capabilities and the capacity of Australian businesses to deliver Defence capability including operational capabilities and the full spectrum of support functions.

The FIC are defined in the ADDP 00.2 - *Preparedness and Mobilisation*.

INTEGRATED LOGISTIC SUPPORT

ILS is a disciplined and iterative approach to materiel management, which addresses supportability throughout the life of the capability, with the aim of ensuring that operational and preparedness requirements are met, at an optimal life cycle cost (LCC), within regulatory, legislative and contractual constraints. ILS is used to design, acquire, establish and manage the support system. Sound application of ILS ensures that the required capability is achieved and sustained. The ILS elements are:

- engineering support
- maintenance support
- supply support
- training support
- personnel
- facilities
- support and test equipment (S&TE)
- computer support (software)
- technical data
- packaging, handling, storage and transport (PHS&T).

As supportability has direct influence on preparedness and life cycle costs, ILS principles and practices are to be applied throughout the capability life cycle to address supportability considerations and must be commensurate with operational, preparedness, regulatory, legislative and contractual requirements. Specifically, ILS practices are applied so that:

- supportability characteristics are an integral part of the considerations for, and the development of, capability and equipment options and impact upon the operational concept, maintenance philosophy and support concept

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- supportability considerations positively influence design requirements and design selection for both the mission system and support system
 - support system constituent capabilities are defined and integrated in order to ensure that the materiel system will satisfy all requirements within available funding
 - considered judgements are made to achieve maximum affect for optimal investment
 - necessary support resources are defined, acquired and implemented
 - supportability is monitored and refined during the in-service phase to ensure that the capability remains effective and life cycle costs continue to be minimised
 - support requirements are addressed during the disposal phase.

The discipline aligns contributors to logistic support and therefore is key to improving business systems integration across the FIC and the consequent improvement of information flows. The implications of not adequately resourcing the ILS aspects of a maritime capability system manifest as greater levels of strategic risk of the degradation of the asset and the reduction in availability over its life. Making provision for an appropriate sustainment funding baseline during the capability definition and acquisition phases is a pre-requisite step to avoiding such degradation through its service.

Analysis of data shows that operations and sustainment costs increase over time. The existing approach to managing the net personnel and operating cost (NPOC) impacts of new projects does not recognise this and often fails to provide an adequate baseline for sustainment funding across the capability's life cycle. The current approach also limits the ability of Navy to effectively manage the combined challenge of ageing platforms and technology obsolescence.

Acquisition costs

Improving support estimation methods at acquisition allows some of the implications of strategic risk to be treated early in a capability life cycle. The increased cost over time for acquisition of Navy's capability is, amongst other factors, attributable to changes in the technology used in successive generations of warships and other maritime capability systems. Typically, navies are maximising the hull lives of platforms and executing multiple major upgrades over a 30-35 year in-service period, with capital ships such as aircraft carriers and major replenishment vessels being extended well beyond 35+ years.

The renewal rate of applicable technologies is often driven by commercial considerations, and in the RAN's case, system interoperability issues with major allies, resulting in a shortening obsolescence cycle for maritime capabilities that must be managed in-service. The two typical controls for this are:

- monitoring of supply chains to recognise the conditions that trigger 'life-of-type' buys or
- avoiding obsolescence by routine upgrade.

Both methods come at a cost, but should be planned as a necessary consequence of using COTS and MOTS acquisitions.

Supportability

System reliability and maintainability is determined through engineering analysis during design and acquisition and as articulated in the support concept. Supportability performance during the in-service phase of a capability's life is ensured by the resourcing of and adherence to the support concept. Supportability is enhanced through engineering examination and approved configuration change processes for any in-service improvement. Flexibility and agility in support is derived from the depth of stock levels, materiel alternatives and warehousing and distribution process. It also dependent on the knowledge, skillsets and capacity of personnel.

Once a mission system is commissioned, the principle impact the organisation can exert on capability outputs is through the application and management of supportability aspects. Supportability is the principal contributor to mission system availability that can be influenced once a capability system is in-service.

Reducing the resourcing of the support system typically results in a reduction in mission system availability and consequent capability. It can be an attractive option during the acquisition phase to maximise resourcing of the missions systems at the expense of downstream support system elements. However, under-resourcing the support system increases the real through-life cost of capability outcome through increased sustainment costs and increased system downtime across the system's life.

Cost prediction

Accurate prediction of life cycle costs requires detailed information and data that is generally not available early in the capability life cycle. Combining the effect of acquisition and upgrade cycles with the observed behaviour of sustainment costs over time allows an improved cost prediction model to be developed that is not compromised by the limited data available early in the acquisition process.

Enabling support can include the level of advantage taken from commonality with other mission systems and need for mission system specific training and accordingly, manpower streams and training facilities. At a broader level, the need to train and support industry skillsets and knowledge is also a cost of support system decisions during acquisition which must ultimately reflect back to the taxpayer.

There are numerous costing models for estimates of life cycle costs. Decisions on the particular costing models used need to take into account:

- historical experience



SL

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- intrinsic and existing support networks (national and international, Navy/ ADO organic and external)
- the scope of the support system to be included.

Maritime support organisations must inform the capability development processes for maritime capabilities, by:

- identifying the supportability and sustainment needs
- designing a proactive and sustainable support system that leverages off and effectively interfaces with existing support frameworks, as much as is practicable and is cost effective to do so
- considering whole-of-life costs and total systems rather than simple, upfront, acquisition costs
- communicating the solution-independent needs of the end-user community
- providing measures of performance (MOP) that are linked to logistics policy documents, and that apply throughout the system life cycle¹².

Failure to implement a structured ILS program early in the capability life cycle, and to manage the program throughout the materiel life cycle, will generally result in an ineffective and inefficient support system which will not be fully able to support the capability when it is deployed. A support system which is inadequate or inappropriate to support the mission system and provide the required preparedness levels would be evident in a number of the following likely outcomes:

- an inability to satisfy the specified preparedness objectives
- an inability to support an operationally deployable and capable mission system
- mission systems which are not capable of operating or being supported in a joint or combined environment

¹² Figure 2.2 depicts the relationship of the importance of early poor decisions and their long term implications.

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- configuration management practices that undermine the integrity of the mission system
 - support policies that do not satisfy the requirements of the mission system
 - excessive and unmanageable life cycle costs
 - inconsistency between the engineering, maintenance and supply support policies, processes and procedures
 - spares, repair parts, consumables and material which are inadequate or inappropriate to support maintenance activities
 - inappropriate packaging, handling, storage and transportation procedures and resources
 - training and training materials not applicable to the support activities
 - inadequate or inappropriate facilities for operations and support
 - inadequate or inappropriate S&TE for the mission and support systems
 - insufficient quantity of personnel and/or skill levels, competencies and experience
 - inadequate or inappropriate mission system data, support for data, or computer support
 - inadequate or inappropriate disposal support.

SUPPORT SYSTEM CONSTITUENT CAPABILITIES

ILS incorporates a set of functional constituents, known as the support system constituent capabilities that determine the supportability of a capability once it enters service. The support system constituent capabilities must be considered for all new or replacement capabilities and address the following concepts and requirements for support of both the mission system and significant support system components:

- What are the specific characteristics?
- What are the main issues (good and bad)?
- What are the potential risks and likely acquisition and life cycle cost drivers and implications?
- What are the potential benefits and likely acquisition and life cycle cost drivers and implications?

Support system constituent capabilities address these questions across the five categories of:

- **operating support** which consists of any specific operating support resources, concepts and requirements needed to enable the mission system to be operated, specifically excluding the other constituent capabilities
- **engineering support** which consists of the concepts and requirements for both the mission system and significant support system components and includes engineering facilities, engineering personnel, support and test equipment, and engineering specific technical data, processes, LIS and software support capabilities
- **supply support** which comprises the concepts and requirements for both the mission system and significant support system components and includes a range of commodities, particularly spares, packaging, handling, storage and transport, supply facilities (warehouse, lay-apart stores etc), supply specialists and supply specific technical data, processes and LIS

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- **maintenance support** which includes the concepts and requirements for both the mission system and significant support system components including maintenance facilities, maintenance specialists, maintenance training equipment, support and test equipment and maintenance specific technical data, processes and LIS
 - **training support** which encompasses the concepts and requirements for training support for both the mission system and significant support system components and includes training facilities, training specialists, and training specific equipment, materials, technical data and training LIS (eg standalone logistic training systems and electronic ‘sandpits’ for training purposes).

Configuration management

Configuration management of both the mission system and support system crosses all support system constituent capabilities and ensures that the ‘maintain, change and control’ disciplines are the overriding support requirements. Effective support of capabilities is reliant on accurate configuration data which must be maintained throughout a capability’s life cycle through clearly defined and controlled configuration change processes.

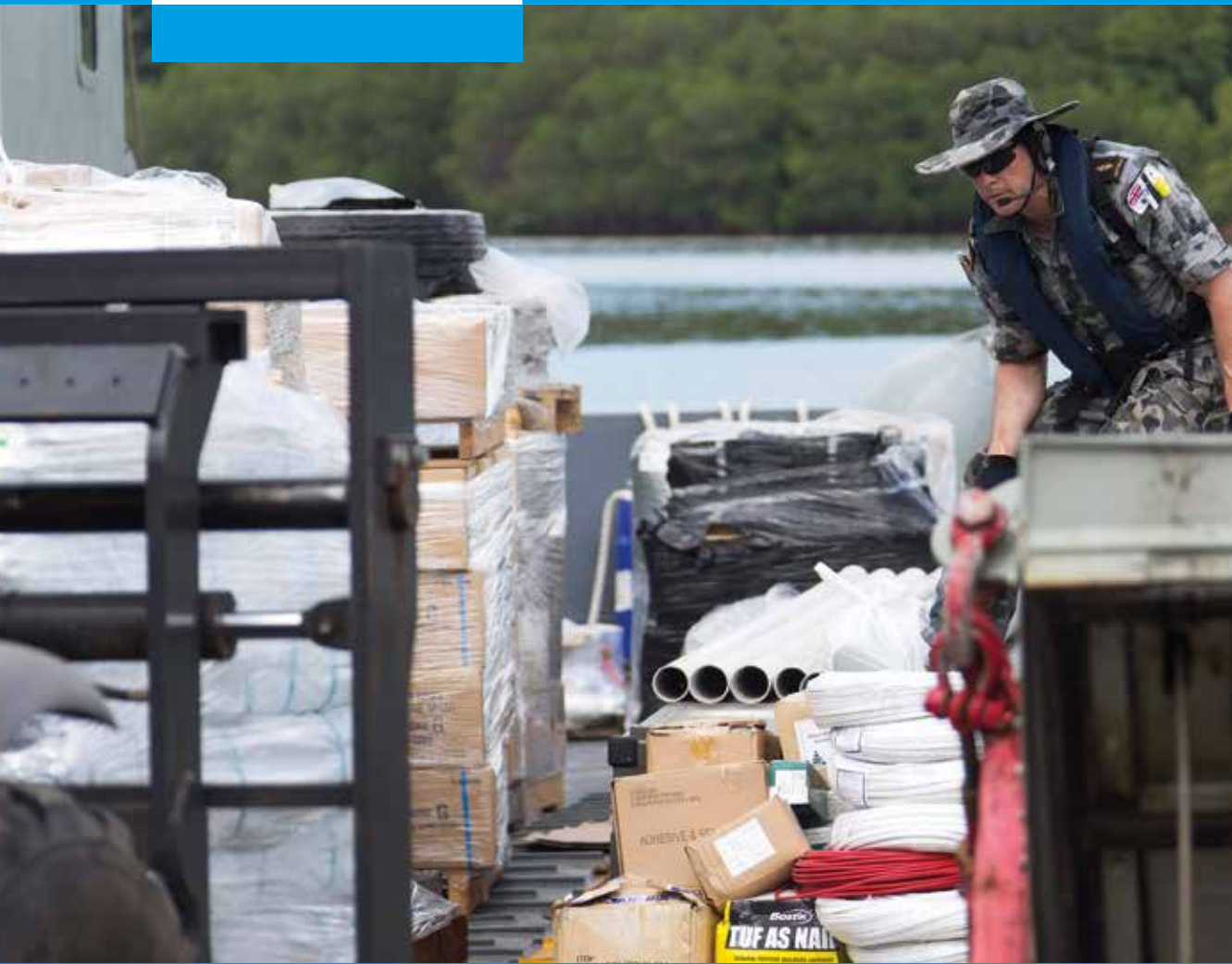
Outputs

The analysis of the support system constituent capabilities determines the impact on facilities, personnel, support and test equipment, technical data, processes, logistic information systems and software support capabilities and the services required from each of the categories. This doctrine addresses the engineering, supply and maintenance support services.

4

CHAPTER

MARITIME CAPABILITY REALISATION AND SUSTAINMENT



MARITIME CAPABILITY REALISATION AND SUSTAINMENT

KEY THEMES

Chief of Navy (CN), as the Navy capability manager, is responsible for the generation and sustainment of Seaworthy capability systems.

Navy's capability systems must be realised with their long term supportability as a key driver.

The transition of a new capability into service must be managed closely and every effort made to ensure that the costs, risks and schedules are understood and clearly broadcast.

Over the last 20 years Navy's capabilities, support concepts and strategies have evolved progressively as Navy and the wider Defence organisation have responded to a rapidly changing world. Navy's organic support has been largely re-focussed to the support of maritime capabilities in a deployed environment and the management of a range of support arrangements with other service provider groups. In turn, the other Defence service provider groups establish and manage a range of contracts to deliver products and services in support of Navy outcomes.

The environment is now one where maritime capability must be delivered within strict controls of fiscal accountability and responsibility, and where operational effectiveness must go hand-in-hand with overall organisational and financial efficiency. However, financial efficiency should not be confused with cost avoidance; a long term view of asset sustainment is needed over the capability system's entire life.



Maritime logistics is a significant cost to Navy but is also one of the key enablers of maritime capability. Maritime logistics must balance operational requirements with mission and support system sustainability. It must seek to be cost effective through innovative business solutions and best practice skills, systems and facilities. It must provide logistics assurance and compliance that ensures Navy meets its governance obligations. Logistics assurance means that Navy must ensure that it is getting value for money and that the capability manager and the sustainment organisation are doing everything that they can to reduce costs whilst maintaining or improving capability. Navy must provide oversight of the support strategies including contracting methodologies and contractor performance management frameworks. Navy must focus on improving its position as a 'smart customer' and continue to develop its responsibilities as an active partner in the provision of support.

COMMAND, CONTROL AND MANAGEMENT

Maritime logistics needs to be understood in terms of an overall system. The actions that deliver Maritime logistics to support operations involve many interrelated processes in a long and highly complex chain of activity. The delivery of maritime logistics by organic Defence elements is supported by a complex network of equipment manufacturers, service providers, industry organisations and international partners through a range of contracts, agreements and memoranda of understanding. This



support network is global in nature and is further complicated by political, cultural, environmental and legal issues, not to mention the tyranny of distance. Adding further to the complexity, is the dynamic nature of the many support systems and the need to tailor them to suit the specific needs of individual and concurrent operations as well as ensuring the appropriate support for warships and other maritime systems across their life cycle. If this system is to function effectively and efficiently, a clear and well-understood command and governance structure is essential.

CAPABILITY REALISATION

Maritime force structure and preparedness requirements

The use of maritime capability can only be fully understood in the context of their broader contribution to national (political) objectives as articulated in the *Defence White Paper*. At the strategic level, capability focuses on defining, gaining Government approval for, and acquiring capabilities over a 15 to 20 year timeframe. The focus is often on the major capital equipment such as major weapons systems, vessels and maritime aircraft managed through the approval process by the capability development agency and acquired by the acquisition agencies. However, capability represents the combined effect of all the fundamental inputs to capability (FIC) that CN must integrate to produce effects for the duration of a capability's life cycle.

As the Navy capability manager, CN is accountable for planning and coordinating the introduction of new materiel into service. Specifically, CN is responsible for identifying capability needs, for defining maritime force requirements, and for exercising oversight and coordination of the FIC elements associated with the introduction into service of the new capability.

Capability realisation is the overarching management function that facilitates coordination of the FIC and oversight of the definition of the need and requirements, acquisition, and activities associated with the introduction of any new capability or capability upgrade affecting Navy. Capability realisation applies to the introduction of any new or replacement capability; moreover, the process is tailorable to suit the size and complexity of the new capability being introduced. Essentially, capability realisation oversees the definition of an endorsed capability, continues during the acquisition of the equipment, and coordinates its introduction into service. Capability realisation is effected through coordination of the FIC using a capability realisation plan (CRP) that details how, when and by whom this will be achieved.

CAPABILITY LIFE CYCLE

The capability life cycle consists of the following phases¹³:

- **Strategic Guidance** which initiates capability concepts
- **Needs determination** when the definition of the need is determined
- **Requirements determination** when capability proposals are developed
- **Acquisition** when the capability is acquired and introduced into service.
- **In-service/operation** when the responsibility for managing the capability is transferred to the CN
- **Disposal** when the capability is disposed of under the coordination of CN and the disposal agency.

¹³ The First Principles Review will lead to changes in the management of the Capability Life Cycle, however, the principles of logistics relevant to progression of capability through its life cycle will remain extant.

This section focuses on how new capability requirements are identified and the major logistic factors of their realisation.

NEEDS PHASE

Navy may identify the requirement for a new or upgraded capability at any time. This may arise from changes in Defence strategy, revised threat assessment, capability planning, concept development and experimentation, simulation and modelling, operational research and analysis, deficiency reporting, planned withdrawal dates for existing capabilities or lessons learnt. Endorsement of the capability need may be through entry of a Navy capability proposal into the Defence Investment Plan, through approval of a Navy minor capability proposal, or may result from an operational need. Endorsed joint projects may also affect Navy capabilities.

Once aware of an endorsed capability need, a sponsor for the capability is identified, and a Capability Program Manager (CPM) will be assigned, whose role is to lead the planning for the introduction of the new capability into operational service. The CPM may establish integrated project teams to assist with this role as required. Depending on the nature and scale of the new capability system to be introduced, the CPM team and CITs may vary from a dedicated team to part-time involvement, and the size of the team/s may vary at different stages of the introduction.

The capability realisation plan (CRP) outlines the capability being introduced and how the FIC elements will be coordinated to realise the endorsed capability. The CRP is a dynamic document subject to ongoing revision as project activities are defined and refined. The CRP may evolve to become the in-service management plan of the new capability or may be integrated into an existing plan.

REQUIREMENTS PHASE

Requirements definition involves transforming an endorsed capability need into a costed, defined solution. For major Defence capital projects, Capability Acquisition and Sustainment Group (CASG) has the lead but requires the capability manager sign-off on the capability proposal before Government approval. For Navy Minor projects, the Navy Sponsor is responsible for defining the capability and its support requirements.

Capability definition documents

Capability definition documents (CDD) comprise a suite of documents used to define the capability required. They are prepared for First Pass approval and refined for Second Pass approval. The CDD consists of the following documents:

- **Operational Concept Document (OCD)** that describes the how, when, where and by whom the capability system will be employed
- **Functional and Performance Specification (FPS)** that provides information on the function and performance of the capability system for both the mission system and the support system¹⁴ (approved following requirements analysis).¹⁵
- **Test Concept Document (TCD)** that details the requirements for accepting the individual capability system components, for assessing that the integration of the components will deliver the required capability, and that the mission system is fully supportable (accompanies FPS).

Acquisition strategy

The acquisition strategy is prepared for the requirements phase and provides the foundation for how the agency will manage all elements of the acquisition process. It describes, at the highest level, how the acquisition of the mission and support systems is intended to be

¹⁴ Described in Chapter 2

¹⁵ For accelerated acquisition projects or directed MOTS/COTS acquisition, the OCD and FPS may be replaced by a set of top level requirements and specifications.

achieved, and is first produced to inform Government decision making on the potential acquisition of a capability option. The strategy will consider such aspects as Australian industry involvement, whether acquisition and sustainment contracts will be with one prime contractor and the type of contract to be executed.

Logistic support concept

The logistic support concept (LSC) outlines the operating, engineering, maintenance, supply and training support requirements associated with each option. The LSC is a critical document as it defines endurance (both of personnel and equipment) and hence capability. The LSC assists with the achievement of reliability, availability and maintainability (RAM) of the capability system and will often be a driver for design change/design selection. Too often in the past, this document has not received the attention required during the requirements phase or has not been maintained during the life of the materiel resulting in sub-standard support. The LSC must be an active document maintained by CASG until disposal of the system. It should, as a minimum:

- define how the capability system will be supported
- forms the basis for determining the materiel sustainment requirements and the cost estimates associated with acquisition and through life-support of the capability system
- inform the crewing and support personnel size and skill level
- define the environment and predicate the personnel requirement ashore and afloat.

Integrated logistic support (ILS) concepts. The LSC outlines the ILS concepts that aim to broadly describe the philosophies, concepts, requirements and constraints associated with the support aspects of the capability system, especially for support during operations. This will describe the integration of the support elements necessary to provide optimum support including detail on the needs of the support system for

the life-of-type and through-life-support. The support concept is used to develop the:

- integrated logistics support plan (ILSP) (acquisition and in-service)
- acquisition strategy
- front end logistics support analysis (FELSA)
- life cycle costing analysis (LCCA)
- net personnel and operating costs (NPOC)
- initial business case
- capability proposal first pass documentation.

ACQUISITION PHASE

Capability acquisition is undertaken by the acquisition agencies and involves developing and executing an acquisition strategy to acquire defined capability requirements. As part of capability realisation, Navy must monitor and report on the acquisition agency's performance in delivering against MAA and other agreements. There may be a need to for a Sustainment Board during acquisition that is aimed at the development of support system.

The broad acquisition strategies are:

- developing bespoke ADF capabilities
- military-off-the-shelf (MOTS) procurement with alignment to the Parent Navy configuration baseline through investment in Parent Navy user groups and forums
- MOTS with variations from the Parent Navy configuration baseline
- COTS used mainly for minor acquisitions.



ADF developed capability

Defence has developed unique capabilities and maintained the baseline as the Parent Navy. This typically requires:

- more time and resources
- significant design effort
- extra sustainment personnel and resources to manage design changes, modifications and obsolescence.

Military-off-the-shelf solutions

Defence has adopted MOTS procurement and acquisition methodologies in an attempt to reduce risk and the cost of ownership and enhance the speed of capability improvement. Whilst MOTS equipment can provide significant savings through the ability to leverage off existing support analysis and data such as technical documentation, training and spares data, equipment will still require a level of Logistic Support Analysis (LSA). The purpose of the LSA is to ascertain the validity of the MOTS data,

as the equipment may be utilised in a different manner or in different environments that would affect the existing support data.

Variations to the baseline. Navy bespoke changes to MOTS equipment must be a last resort approach and adopted only in the most exceptional circumstances. It must be clearly understood that altered or 'Australianised' MOTS systems are no longer, by definition, MOTS. Variations to the baseline increase costs, require significant support effort to comprehensively accept into service and have significant obsolescence issues. Additionally, MOTS equipment that requires integration into a larger system will also need significant analysis to ensure that the equipment is not altered to such a state that it loses its MOTS status.

Original equipment manufacturer (OEM)

Original equipment manufacturer (OEM) designed global support and management systems that arrive with new generation capability acquisitions have the potential to introduce variant support processes. Critically, Navy requires high levels of information fidelity and data sharing with the support contractor and sustainment organisation. To satisfy this information requirement, Navy must ensure that future materiel support systems are carefully designed to prevent:

- fragmentation of processes and data systems, resulting in potential loss of fused data and information required for timely decision making and stewardship of the supply chain
- potential loss of agility and resilience in the supply chain from misapplication of 'just-in-time' strategies
- a reduced ability to influence the response of the supply chain to priority war fighter demands
- duplication of the training burden across multiple support systems
- limitations on and inaccuracy in reporting deficiencies across platforms and groups

- inability of support personnel within Defence to apply standard methodologies and processes across different support agencies
- a confused asset and control picture.

Challenges such as the trend for OEM to control intellectual property and license or control vendors must be recognised and addressed. Defence must be able to capture performance information and operate in an informed manner in managing ADF capabilities.

ACCEPTANCE INTO OPERATIONAL SERVICE (AIOS)

The inadequate maintenance and sustainment practices have many causal factors. They include poor whole of life asset management, organisational complexity and blurred accountabilities, inadequate risk management, poor compliance and assurance, a 'hollowed out' Navy engineering function, resource shortages in the System Program Office in DMO, and a culture that places the short-term operational mission above the need for technical integrity. In addition, Navy and DMO need to improve coordination and integrate their interdependent activities more effectively. Whilst the overall outcome is a poor reflection on Defence and DMO, actions by individuals were taken, in the main, to meet the operational demands of the day with inadequate resources and tools.

Paul J Rizzo, July 2011

Plan to Reform Support Ship Repair and Management Practices

Delivering maritime capability into service is a large-scale, complex and critical undertaking, requiring close management of each capability project's planning, acquisition and acceptance phases. It typically involves the coordinated and integrated effort of several large Defence and private sector organisations with capability outcomes dependent on management being well positioned to identify whether projects are progressing as planned and to respond to emerging issues. Project risks need to be managed by all parties, with all organisational relationships focused on delivering the specified Maritime Capability within the approved cost and schedule.



AIOS is the process of proving that FIC elements meet endorsed capability requirements, and confirming the capability is acceptable for operational service. AIOS must commence very early during the Acquisition Phase, via a Preliminary Transition Plan as part of the CDD suite and needs to continue to ramp up through to Final Operational Capability (FOC). AIOS involves numerous activities to transform FIC to achieve endorsed project outcomes; these activities can span Group, Service and organisational boundaries. The transition from Capability Support to Operations Support also occurs during the AIOS process. Capability Realisation culminates in Operational Release (OR) of the capability system.

Transition to In-Service Management

Although NAVSTRATCOM is responsible for the introduction of new Navy capability systems, the in-service management of these capabilities resides with the Fleet Commander. This ultimately means that capability management responsibility for the new capability system must transition to the in-service CM Representative, normally the Force Commander responsible for the capability system. In some cases, especially if the capability introduction is to take some extended period or if the new capability system involves upgrade of an existing platform, the CM Representative and the CM may share capability management responsibilities for specific aspects on a new capability project. The Capability Realisation Plan should detail management arrangements,



including costs, risks and schedules, for the introduction of capability and how the associated capabilities will transition from existing, through future, to current capability management.

Capability Realisation Plan (CRP)

A CRP is a project-specific plan developed to identify the activities required to, not only introduce the new capability into service, but to also fully realise the new capability's potential. The CRP outlines how the CM will coordinate the various FIC elements to most effectively realise the agreed new capability within the approved cost and schedule. The CRP is the responsibility of NAVSTRATCOM, co-developed with CASG, and input from all those involved in acquiring and introducing the capability into service. The CRP development effort is supported and informed by FIC Leads through their development of individual FIC Plans. A draft CRP will be developed in the Requirements Phase in the lead up to Second Pass (Acquisition) Project Approval, and then further developed and maintained in accordance with the Joint Project Directive and Strategic Policy as Acquisition progresses through to in-service.

IN-SERVICE PHASE

The Navy Operations Support Model

Navy consistently faces the challenge of consecutive and concurrent operations in multiple theatres. Many of these are long-term commitments, and each has required a distinct set of Maritime Capabilities. Throughout this Phase, Force Commanders are responsible for managing the capability implicit in each vessel or unit from entry into service until disposal, on behalf of the Fleet Commander and CN as the CM. This is a management rather than a command function. Commanding Officers of ships and units are responsible for the operational effectiveness and safe conduct of their unit and the safety of all personnel onboard.

In-service Management. The Fleet Commander and the Force Commanders are responsible for in-service management of assigned capability systems. This requires the continuous management of the FIC, many of which are either provided to Navy by or heavily enabled by other Defence organisations under a range of inter-organisational agreements (including MSA) that encompass all aspects of materiel support including:

- inventory management
- development of Product Schedules (described below)
- maintenance and planning
- engineering and technical support
- disposal management
- contract management
- other enabling services.

Product Schedules (PdS). The Navy MSA is broken into a set of subordinate PdS that, in the main, support specific Navy materiel systems. PdS are contract-like documents that detail the level of support

to be provided by the sustainment organisation, and the cost of providing that support. They also articulate Navy's responsibilities with regards to asset management; for example, adherence to usage upkeep cycles. The level of support required is derived from the capability requirements as prescribed by CN. As an example, a PdS for a maritime system will encompass a range of performance requirements such as:

- **Inherent reliability.** This is the calculated probable percentage of time that the mission systems were designed to perform without logistic support. Reliability levels may be categorised by mission sub-system.
- **Materiel availability.** This is the percentage of time that mission systems are required to be materially available for tasking with full organic logistic support embarked. Availability may be further defined by type of task (eg training, national tasking, operations).
- **Materiel supportability.** This includes the maintenance effort required to ensure the system is supportable and consists of:
 - inherent design features that enable organic support
 - the ratio of corrective to preventive maintenance
 - whether the demands upon the supply chain are commensurate with expectations
 - the responsiveness of the support system to surges in activity.

Conduct of Operations

During operations, CJOPS is responsible for employing assigned capabilities to prosecute operations; however, as CM, CN remains responsible for maintaining and sustaining the capability system. Additionally, CN may command Maritime Capabilities for specific operations.

Operations entail a range of challenges beyond those routinely encountered during in-service management. These include the possibility of increased activity levels, usage rates, different operating environments, changed support arrangements, an extended supply chain and distance

from deeper maintenance facilities. These challenges will also differ according to the phase of the operation:

- Preparation
- Sea Release
- Operations
- Re-generation/Reconstitution.

Commanding Officers are responsible for ensuring that their vessel or unit moves through the Preparation Phase and subsequent Work-Up Phase to reach the Operations Phase of the continuum. This responsibility includes ensuring that the vessel or unit is fully crewed, appropriately trained and mission ready.

Preparation Phase

Navy is always preparing for the next contingency. Consequently the preparation phase equates to Navy's routine activities. The preparation phase also involves a warning period when an individual, vessel or unit is identified and formally advised of a possible contingency. During the preparation phase the Fleet Commander ensures that Navy's fleet has the capabilities stipulated in strategic guidance. For a particular contingency the Fleet Commander must ensure that the force generation requirements are shaped by:

- government policy objectives and the strategic concept
- an understanding of the military conditions for success and end-state
- assessment of the threat
- the forces available and their readiness
- the time available to respond
- the likely duration of the campaign.

To ensure each vessel or unit is appropriately prepared for its intended employment, the Fleet Commander expects each Force Commander to develop a plan that meets known operational, preparedness, exercise and international engagement requirements for the vessel or unit. The Force Commander then coordinates the input of the various service providers and suppliers who collectively enable the vessel or unit to meet the Fleet Commander's requirements. Fleet HQ also performs a vital role during the Preparation Phase by coordinating activity between Force Commanders and providing specialist logistic, personnel and engineering advice and support to the Force Commander's staff, as well as the various vessels and other maritime assets.

Typically, during this phase, the focus is upon repair and maintenance, inventory management, and individual, team and collective training. This phase will also include periods of equipment tests and evaluation. If significant and lengthy maintenance has taken place during the Preparation Phase the period will conclude with detailed materiel and safety inspections as well as intensive training periods for all personnel to ensure the vessel or unit is safe and ready to proceed to sea.



Sea Release

The preparation for ships for Sea Release is described in the Sea Release Assurance Framework (SRAF). The SRAF is a multi-layered structure that enables Fleet unit to generate the required levels of readiness through standardised and disciplined processes. The SRAF provides the certification required and defines the levels for Fleet Units to achieve assurance of Seaworthiness progress from its scheduled upkeep (maintenance period) to usage (operational and capability) cycle during its in-service design life. Further information regarding Sea Release is available in the SRAF Information Booklet available from Fleet Command.

Operations Phase

The operations phase is effectively the conduct of operations or assigned tasks in accordance with promulgated orders or an exercise directive. Deployment to a theatre of operations involves mounting, embarking and sailing the force from home or mounting bases, passage to the area of operations, and arrival in the theatre of operations in a posture appropriate to the threat and mission. HQJOC coordinates support to vessels or units throughout the operations phase.

Operational Viability Period (OVP). OVP is a key determinant of the structure of the support system. The OVP is the period immediately following deployment on operations during which deployed forces must be self-sufficient until the logistic resupply system can be enacted. The OVP is determined by logistics staff in close consultation with the operations staff. The OVP is influenced by the '4 Ds' of destination, distance, duration and demand:

- **Destination.** The capability at the destination to resupply the task group or vessel is a key determinant of the OVP. For instance if fuel can be provided locally, the OVP for these items may be less than for items that can only be supplied through the supply chain from the NSB.

- **Distance.** The distance determines the time taken to move materiel to the theatre and shapes the volume of organic stocks that the force must deploy with.
- **Duration.** The duration of operations will determine the overall volume of materiel requirements and helps determine whether a supply chain must be established eg for a short duration humanitarian operation, the task group may be able to load sufficient materiel for the duration of the operation; whereas, for a long-term operation such as the Frigates that have been on-station in the Middle-East, fixed supply chain arrangements, including contracted support, have been put in place.
- **Demand.** The volume and complexity of the demand matched against the capacity to hold or move the materiel also determines the size of the OVP

The OVP for Navy force elements is calculated at:

- the operational level by Fleet HQ, particularly during the initial deployment phase of an operation
- the tactical level by the vessel or unit to support operations where limited resupply is expected.

Re-generation and reconstitution phase

Regeneration. Regeneration extracts forces from the theatre of operations and reconstitutes them in preparation for subsequent operations. Regeneration is a complex phase involving a range of concurrent activities. Specialist support elements may be established to coordinate regeneration activities and assist unit commanders. Regeneration activities include the following:

- drawdown, which is the graduated reduction and withdrawal of forces from the theatre, and may include the identification, accounting, refurbishment and dispatch or disposal of material
- movement of forces to home ports or other assembly areas, which largely mirrors the deployment phase in reverse

- continuation, transfer and/or cessation of in-theatre logistic support
- reconstitution of ships and units, which may be a short or long term activity depending on the degree of remediation required.

Reconstitution. Reconstitution is the process by which, at the conclusion of the operations phase, individuals, vessels or units re-assume or recover to directed preparedness levels required by strategic policy. The Reconstitution Phase begins with the redeployment of forces from the operational area and concludes when the forces are returned to the Preparation Phase. Reconstitution is not aimed at rectifying any enduring deficient areas in Navy, such as shortages of specialist personnel. Reconstitution focuses upon respite for personnel, recovery of the material condition of vessels and units, and rebuilding of skills levels.

Reconstitution is an entrenched part of the operational planning process and is acknowledged as a whole of Navy activity. Prolonged heightened levels of maritime operational tempo during the first years of the 21st Century have reinforced the importance of the Reconstitution Phase. Navy's opportunity to reconstitute will be determined by government operational priorities. Navy has limited discretion in this regard, so must be prepared to capitalise on periods of reduced operational tempo in order to reconstitute.

Navy's commitment to reconstitution activities may require reduced participation in exercise activities, international engagement opportunities, and also a reduced level of preparedness for short notice operations. The appropriate balance between these extant commitments and reconstitution objectives will be determined by CN and will be reflected in vessel or unit scheduling within the Force Generation Plan (previously the Fleet Activity Schedule).

Reconstitution must be undertaken in a focused manner, guided by a strategic-level plan that specifically addresses the areas of capability that have been eroded by the operational employment. A clear reconstitution end-state must be described and resources must be assigned to achieve

these identified objectives. Areas to be considered in a reconstitution plan include:

- customs and quarantine requirements.
- personnel aspects, particularly leave, career development of individuals, and individual position prerequisite training
- maintenance, repair and materiel condition, including auditing of major systems
- collective training in warfighting skill areas not utilised during recent operational employment
- inventory replenishment
- team building and reinvigoration activities such as sport and adventure training.

Based on the priorities agreed in the strategic level Reconstitution Plan, each vessel or unit Commanding Officer is to ensure that reconstitution objectives are achieved. FHQ and Force Commanders also have a role to play in delivering a fully reconstituted capability at the conclusion of the Reconstitution Phase.



NAVY OPERATIONAL SUPPORT PLANNING

The aim of any military organisation is to produce the most effective combat power with the resources available, and planning is a critical factor in achieving this effect. Properly prepared, deployed and employed logistics support is capable of increasing the level of combat capability deployed forward. Furthermore, effective planning can enable the logistics footprint to be reduced, improve Maritime Logistics effectiveness, and reduce the amount of sealift and other lift required to provide support.

Maritime Logistics planning is conducted to provide specialist input into the broader staff planning effort. Planning is required for the participation of ships and units in the following tasks:

- **Operations.** In general, planning for operations will be led by HQJOC. HQJOC will request specialist advice from Navy staff to ensure specialist maritime planning guidance and input is included in the Joint Military Appreciation Process (JMAP).
- **Exercises.** Planning for exercises can be led by various elements depending on the scope, scale and purpose of the exercise. Multinational and joint exercise planning will be led by MAROPS or FHQ.

Navy will also provide planning support to unilateral exercises being conducted by foreign navies.

- **Other activities.** Other activities include visits, family sea days, trials and support to other Defence agencies. Planning for such activities will be coordinated by the lead agency and will require various levels of Navy participation.

Planning Process

Within the ADF, planning for operations is categorised as either deliberate or immediate depending on the time available to undertake planning before execution. Collaborative Planning is the formal means of achievement of balancing capability requirements for missions with maintenance requirements for materiel seaworthiness over a recurring two year planning period. The business rhythm of Collaborative Planning aims to develop as an output the funded Product Schedule over a progressively maturing understanding of the various input, output, constraint and resource requirements.

Deliberate planning. Deliberate planning is conducted at all levels of command and is ‘planning for the possible’. Deliberate planning will normally be assumption based and is characterised by long lead times.

- **Preparedness planning** is focused on developing plans to meet specific preparedness requirements and to identify capability gaps. These plans are developed by the Force Commanders as part of CN’s capability management responsibilities. Commanders at all levels must ensure that Operational Logistics Plans, Usage Upkeep Cycles (UUC) and Usage Upkeep Plans (UUP) exist and appropriate arrangements are in place to meet stated preparedness requirements for their capabilities.
- **Operations support planning** primarily involves the development of plans to meet operational requirements. It also identifies the sustainability requirements of preparedness and to support contingency planning. This is a deliberate planning process wherein plans based on approved scenarios are progressively developed in advance of potential

operations.

Immediate planning. Immediate planning is situation specific and is ‘planning for the likely or certain’. The immediate planning process must be flexible and will normally be time sensitive due to the nature of tasks. Immediate planning will always be required to meet the needs of specific operations. Ideally, immediate planning should use prepared deliberate plans and adapt these to meet the current operation.

SOURCES OF SUPPORT

Commercial Support

The increase in inventory costs relating to capability assets and the development of partnerships has become an important consideration for logistic staff. Increasingly, Navy is reliant on contractors for the provision of sustainment stores and services, including engineering and maintenance support.

Commercial support is predicated on Navy understanding its requirements in detail. Contractors expect Navy to know what their ‘surge’ requirements are so they can be clearly expressed and financially provisioned for in the maintenance and technical support contracts.

Navy must seek to manage its requirements to ensure an even spread of tasks to provide a relatively predictable workload to foster a sustainable maritime support industry. Partnerships are developed where a mutual benefit for Defence and the supplier of Stores, engineering services, maintenance services and or training can be established. Partnerships can be established for the provision of spare parts, maintenance and engineering services through lease agreements for capabilities and in the provision of supply services.

Vendor managed inventory

Many capabilities are based on commercial derivatives or commercial-off-the-shelf (COTS) and military-off-the-shelf (MOTS) systems. These capabilities typically have established supply chains and spare parts pools to which Defence gains access. The philosophy underpinning vendor managed inventory is to reduce the total cost of ownership to Defence whilst maintaining or improving operational readiness. The intent is to take advantage of global supply chains, commercial spares pools and best commercial practice in managing spares pools with a resultant reduction in system life cycle cost. This must be balanced against preparedness requirements and a level of insurance to offset supply chain security issues.

The use of vendor managed inventory, where deemed appropriate and cost effective for either legacy or new capabilities, should be considered as part of the acquisition strategy. Vendor managed inventory is being sought to:

- reduce Navy inventory levels and associated management, cost of warehousing, facilities maintenance and governance requirements
- reduce through-life support costs to Navy while maintaining or improving preparedness levels
- take advantage of commercial spares pools and best commercial practice in managing spares pools
- include arrangements for contractors to improve reliability, availability and maintainability while meeting required preparedness levels, regardless of location
- apply generally to those items, which are valuable, unique or exclusive; although items which are common across a number of platforms/ weapon systems could be included in performance based contracts that call for system-level performance
- provide a service to Navy that is compliant with extant regulations.



Multinational support

Most ADF operations are conducted as part of a multinational force. The differences in national organisations, materiel and procedures must be well understood, particularly by commanders exercising control over, or participating within multinational logistic elements and groups. Factors to consider include:

- When operating with international partners Navy is often a customer, not a full partner, with limitations on capacity to influence the supply chain and processes.
- When the Navy is a smaller member of the multinational force, its access to key harbours and ports may be restricted due to the greater demands of the larger forces.
- Assistance to expand the infrastructure, facilities and capabilities from multinational partners requires additional time and increased costs.
- There is typically limited standardisation of equipment between nations, although the US, Canadian, New Zealand Navies and some Pacific nations have greater materiel commonality.

- Logistic organisations at each level of command differ nationally, and while missions and tasks are similar, procedures often vary, particularly when providing support.

Support from and within a multinational force will vary considerably depending on the contributing forces agreement in place. Support is ordinarily limited to materiel provision as services such as maintenance and engineering are predominately provided through individual supply chains and support systems.

Where Navy has Lead Nation status, the expectation is that it will provide policy and guidance on procurement for the forces from contributing nations. Key considerations include:

- rate of effort of supported vessels and other equipments
- how materiel screening are conducted
- how parts being transferred to other navies are accounted.

Cost capture becomes a primary consideration for procurement of common items, such as fuel. Normal considerations for procurement exist in a coalition force; however, accurate apportioning of costs to partners is required when the procurement function is centralised. Navy must maintain records of procurement to seek reimbursement at the government and departmental level.

As described above, Defence logistics staff will either execute an existing arrangement (typically a Mutual Logistic Support Agreement (MLSA)) or develop a new arrangement. Additional information is provided in *The Handbook of International Logistics*.



Sealift

Vessels provide mobility in mass, or sealift; the ability to transport large numbers of people and quantities of cargo over significant distances. To transport personnel and equipment into theatre and conduct logistics over-the-shore (LOTS), the maritime force requires safe and secure access to ports of embarkation (POE), ports of disembarkation (POD) and their maritime connectors - sea lines of communication (SLOC). Agreements with Australian and foreign governments, shipping operators, and port owners will continue to be necessary to access:

- Australian ports and facilities within the NSB
- foreign ports and facilities within the area of operations
- amphibious landing areas.

DISPOSAL PHASE

Disposal is the process of transferring or relinquishing ownership of assets, including inventory, by Navy. Although identified as a discrete phase in the capability systems life cycle, disposal (like equipment acquisition) can occur during the in-service phase, when equipment is replaced through capability upgrades or for supportability reasons.

Disposal of current capability is often overshadowed by the introduction of new capability systems into service. Nevertheless, poorly conducted disposals can have adverse effects on Navy in terms of direct and indirect costs, as well as, damage to the environment and reputation. Additionally, disposal considerations can contribute significantly to the rest of the capability systems life cycle. This is particularly relevant when developing strategies to deal with equipment and systems with extended life cycles. Decisions can be made in acquisition to manage obsolescence and capability injection through the regular turnover of equipment. This strategy may see equipment disposed of mid-life, whilst still serviceable, to reap a worthwhile return that can be reinvested into a new capability.

There is a range of reasons why equipment is disposed of, not all of them associated with the system coming to the end of its life-of-type.

- **Operational capability.** The performance of capability system may no longer be able to matched current or likely future threats.
- **Obsolescence.** The capability system as a whole or some of its sub-systems may no longer be economically sustainable.
- **Expiry.** Many products, such as elastomerics, blood and pharmaceuticals have set expiration dates.
- **Safety.** Many items may be disposed of if subject to an event or standard change that might impact on their continued legal and safe usage (eg asbestos, detergents and material with polychlorinated biphenyls (PCB)).

- **Excessive inventory.** Inventory requires infrastructure for its storage, and staff for its administration and maintenance. Excessive inventory represents unnecessary costs to Defence.
- **Capability injection strategy.** It may be more cost effective to retire a capability system early due to increasing supportability costs, and replace it with a more modern system.
- **Cost.** The Government may simply reduce Defence expenditure.

Disposals must be analysed from a cost effectiveness purpose. At present disposal basically only occurs as a result of obsolescence or items no longer being repairable. Focus needs to be addressed to system analysis and the gathering of commercial intelligence that identifies optimised life-of-type rather than operating a system until it is no longer supportable.

Disposal process

The disposal function includes:

- identification of assets for disposal including the mission system and all the relevant support system components such as parts, support and test equipment and documentation including training materials
- development and implementation of disposal plans
- adjustment of asset and financial records.

Disposal on operations

Often it is not economic or practical to return equipment and items from overseas to Australia. In many cases, the cost of transportation is in excess of the value of the item. In other cases, quarantine or other regulations preclude its return. In these cases, the item may be disposed of using approved outlets in the host country. Of particular note, sea-dumping, burying or any other method of disposal, that may attract public criticism nationally or internationally, is not to be used without prior approval. In some cases when adequate disposal of items cannot be achieved in the host country the item may need to be returned-to-

Australia or destroyed. Proper accounting for write off of disposed items is essential. Additionally the Government may authorise materiel to be gifted (donated) to another organisation, such as the host nation or a non-government organisation.



GLOSSARY

The source of the majority of terms, abbreviations and acronyms for approved Defence terms, definitions and abbreviations is the Australian Defence Glossary (ADG), available on the Defence Restricted Network. The ADG is updated regularly and should be checked for amendments to the entries in this glossary.

agreed point

The location where the responsibility for materiel in the supply chain transfers to a subordinate, or in the case of retrograde activity, to a superior, network manager.

availability

The ability of an item to be in a state to perform as required. Availability depends upon the combined characteristics of the reliability, recoverability, and maintainability of the item, and in some cases, on the maintenance support performance. Availability may be quantified using appropriate performance measures.

capability

The power to achieve a desired operational effect in a nominated environment within a specified time and to sustain that effect for a designated period.

Note: In a military context, capability is achieved by developing a force structure appropriately prepared for a range of military operations.

corrective maintenance

Action/s taken to restore operational capability when there is evidence of degradation, an impending failure or following a system failure.

dependability

The ability of an item to perform as and when required. Dependability includes availability, reliability, recoverability, maintainability, and maintenance support performance, and, in some cases, other characteristics such as durability, safety and security. Dependability is used as a collective term for the time-related quality characteristics of an item.

deployment

1. The relocation of forces to desired areas of operations.
2. The movement of forces within areas of operations.
3. The positioning of forces into a formation for battle.

distribution

1. The operational process of synchronising all elements of the logistics system to deliver the right things to the right place at the right time to support the geographic combatant commander.
2. An official delivery of anything, such as orders or supplies.

engineering support task analysis

Engineering support task analysis determines the requirements for engineering support for both the mission system and significant support system components and includes the review of engineering facilities and personnel, support and test equipment, technical data, processes and logistic information systems (LIS).

equipment

All non-expendable items needed to outfit/equip an individual or organisation.

Note: May be qualified by referring to items as major or minor capital equipment.

explosive ordnance (EO)

All munitions containing explosives, nuclear fission or fusion materials and biological and chemical agents.

Notes:

1. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket and small arms ammunition; all mines, torpedoes and depth charges, demolition charges; pyrotechnics; clusters and dispensers; cartridge and propellant actuated devices; electro-explosive devices (EED)s; clandestine and improvised explosive devices (IED)s; and all similar or related items or components explosive in nature.

2. Used as a generic term in the same sense as the term 'ammunition and explosives' is used in the equivalent NATO AASTP-1.

failure modes and effects analysis (FMEA)

A top-down analysis to determine critical systems.

failure modes, effects and criticality analysis (FMECA)

A bottom-up analysis to determine critical items within critical systems.

force element (FE)

A component of a unit, a unit, or an association of units having common prime objectives and activities.

force preparation

Comprises training, health and administrative preparation, and the issue of and competency with mission specific equipment to ensure deploying forces have reached an appropriate level of readiness to enter the joint force area of operations (JFAO).

Note: This is the final link in the process of preparing a force element (FE) for an operation, and draws upon pre-existing levels of preparedness provided by the Service Chiefs.

foreign military sales (FMS)

That portion of United States security assistance authorized by the Foreign Assistance Act of 1961, as amended, and the Arms Export Control Act of 1976, as amended. This assistance differs from the Military Assistance Program and the International Military Education and Training Program in that the recipient provides reimbursement for defense articles and services transferred.

fundamental inputs to capability (FIC)

A standardised checklist of nine inputs, designed to enable the effective generation of Defence capabilities.

Note: In line with the generic definition of Defence capability, the FIC can be used as an aid to management at all levels of Defence.

hazardous material (HAZMAT)

Material that may pose a risk for the population, property, safety or the environment owing to its chemical or physical properties or the reactions that it may cause.

host-nation (HN)

A nation which, by arrangement:

- a. receives forces and materiel of other nations operating on/from or transiting through its territory;
- b. allows materiel and/or organisations to be located on its territory; and/or
- c. provides support for these purposes.

host-nation support (HNS)

Civil and military assistance rendered in peace, crisis or war by a host nation to NATO and/or other forces and NATO organisations which are located on, operating on/from, or in transit through the host nation's territory.

inherent reliability

The reliability incorporated into the initial design of a mission system.

information and communications technology (ICT)

The applied science and engineering aspects related to the creation, manipulation, presentation, dissemination etc of data for the communication of information between users.

infrastructure

Generally applicable for all fixed and permanent installations, fabrications, or facilities for the support and control of military forces.

inventory

A generic term indicating Commonwealth owned items held on charge on the accounting system in store (including loan pools).

joint

Activities, operations and organisations in which elements of at least two Services participate.

Note: When all Services are not involved, the participating Services shall be identified, for example Joint Navy-Army.

level of repair analysis (LORA)

The analysis undertaken to determine the most suitable locations and organisations for the conduct of each maintenance task to determine the individual maintenance policies for each component and define a system maintenance plan.

line of communications (LOC)

A route, either land, water, and/or air, that connects an operating military force with a base of operations and along which supplies and military forces move.

logistics

The science of planning and carrying out the movement and maintenance of forces.

Note: In its most comprehensive sense, the aspects of military operations which deal with:

- a. design and development, acquisition, storage, movement, distribution, maintenance, evacuation, and disposal of materiel;
- b. transport of personnel;
- c. acquisition or construction, maintenance, operation, and disposition of facilities;
- d. acquisition or furnishing of services; and
- e. medical and health service support.

logistic support analysis

A systematic and comprehensive analysis conducted on an iterative basis through all phases of the life cycle to operate and maintain the system/ equipment objectives in a cost effective condition

maintainability

The ability of an item to be retained in, or restored to a state in which it can perform as required, under given conditions of use and maintenance. Given conditions of use include aspects that affect maintainability, such as: location for maintenance, accessibility, maintenance procedures and maintenance resources. Maintainability may be quantified using appropriate performance measure.

maintenance

1. All action taken to retain equipment in or restore it to a specified condition, including inspection, testing, servicing, classification as to serviceability, repair, rebuilding and reclamation.

2. All supply and repair action taken to keep a force in condition to carry out its mission.

3. The routine recurring work required to keep a facility (plant, building, structure, ground facility, utility system or other real property) in such condition that it may be continuously utilised, at its original or designed capacity and efficiency, for its intended purpose.

maintenance engineering

The application of techniques, engineering skills, and effort, organised to ensure that the design and development of weapon systems and equipment provide adequately for their effective and economical maintenance.

maintenance support task analysis (MSTA)

The analysis required to determine the logistic resources such as personnel, spares and tools necessary to support these requirements.

maritime logistics

Maritime logistics is the science and art of generating and sustaining Navy materiel capability with the emphasis on integration and synchronisation of engineering, maintenance and supply support functions.

materiel

All items necessary to equip, operate, maintain and support military activities without distinction as to its application for administrative or combat purposes.

Note: May include ships, tanks, self-propelled weapons, aircraft, etc, and related spares, repair parts and support equipment but exclude real property, installations and utilities.

materiel logistics

The aspect of logistics concerned with the whole-of-life of an item, from its conceptualisation to its realisation, use and eventual disposal requiring a

detailed and accurate knowledge of the functional, product and certified configuration baselines of the class, unit, systems and fitted equipment at all stages of the life cycle.

movement

The activity involved in the change in location of equipment, personnel or stocks as part of a military operation, and requires the supporting capabilities of mobility, transportation, infrastructure, and movement control and support functions.

national support base (NSB)

Encompasses the full range of organisations, systems and arrangements, both formal and informal that own, control or influence ADF access to, and the use of, capability.

Note: in geographical terms, the national support base refers to the Australian nation.

node

The point at which resources are acquired, maintained, stored and moved from one mode to another.

non-materiel logistics

Operating support; personnel support; facilities and training areas; warehousing and distribution; and the provision of consumable items of supply (including but not limited to) food, fuels and lubricants and explosive ordnance.

operating support task analysis

The analysis undertaken to review specific operating support resources, concepts and requirements needed to enable the operation of the mission system.

operation

A series of tactical actions with a common unifying purpose, planned and conducted to achieve a strategic or campaign end state or objective within a given time and geographical area.

operational viability period (OVP)

The period during which a deployed Defence element must be able to sustain itself until the mechanisms of the operation sustainability period are established.

preparedness

The measurement of how ready and how sustainable forces are to undertake military operations.

Note: It describes the combined outcome of readiness and sustainability.

preventive (or planned) maintenance

The periodic survey, measurement, oil change, replacement of worn components or the overhaul of equipment or sub-systems prior to failure in order to promote continuous system operation at designed levels of performance, reliability and longevity.

Note: Preventive maintenance includes condition assessment and inspections / surveys.

readiness

The ability of a Defence element to be committed to a specific activity within a nominated timeframe.

Note: It assumes the availability of appropriate competencies and other fundamental inputs to capability to provide an acceptable level of risk.

reliability

The ability of an item to perform as required, without failure, for a given time interval, under given conditions.

reliability, availability and maintainability (RAM)

Specialised materiel engineering discipline concerned with reliability, availability and maintainability.

reliability centred maintenance (RCM)

The critical analysis of equipment operation, environment, fault modes and effects to develop preventive and corrective maintenance schedules that best avert or mitigate loss of operating time.

replenishment at sea (RAS)

Those operations required to make a transfer of personnel and/or supplies when at sea.

services

Those elements of infrastructure that provide a service to people or facilities.

Note: This includes water supply, electricity supply, lighting, heating, air-conditioning, refrigeration, hazard reduction and waste disposal measures.

supply

The procurement, distribution, maintenance while in storage and salvage of supplies, including the determination of kind and quantity of supplies:

- a. Producer Phase. That phase of military supply which extends from determination of procurement schedules to acceptance of finished supplies by the Services.
- b. Consumer Phase. That phase of military supply which extends from receipt of finished supplies by the Services through issue for use or consumption.

supply chain

The process of planning, implementing and controlling the efficient and effective flow and storage of goods, services and related information from point of origin to point of consumption for the purpose of conforming to customers' requirements.

supply chain management

A cross-functional approach to procuring, producing, and delivering products and services to customers.

Note: The broad management scope includes sub-suppliers, suppliers, internal information, and funds flow.

supply support

The organisation of hardware, software, materiel, facilities, personnel, processes and data required to enable supply services to be competently provided by the materiel system. It includes the support resources of spares, piece parts, consumables and packaging materials.

supply support task analysis (SSTA)

Analysis to determine the materiel requirements to support integrated logistic support deliverables for a platform/system.

support

The action of a force that aids, protects, complements, or sustains another force in accordance with a directive requiring such action.

support system

The organisation of hardware, software, materiel, facilities, personnel, processes and data required to enable the mission system to be effectively operated and supported so that the mission system can meet operational requirements. It includes the support required for support system components. It embraces the support responsibilities undertaken by Defence, in-service support contractors and in-service support sub-contractors.

supportability

The degree to which the mission system design characteristics and the planned or existing support system enable preparedness requirements to be met.

sustainability

Operational sustainability. The ability of a force to conduct operations for the duration required to achieve its assigned operational tasks.

Note: Measured in terms of personnel, equipment, facilities and consumables.

Strategic sustainability. The ability of Defence to maintain its elements to meet Government expectations, over time.

sustainment

The provision of personnel, logistic, and other support required to maintain and prolong operations or combat until successful accomplishment or revision of the mission or of the national objective.

system

A functionally, physically, and/or behaviourally related group of regularly interacting or interdependent elements; that group of elements forming a unified whole.

theatre

A designated geographic area for which an operational level joint or combined commander is appointed and in which a campaign or series of major operations is conducted.

Note: A theatre may contain one or more joint force areas of operations.

training support task analysis

Analysis used to analyse the concepts and requirements for training support for both the mission system and significant support system components including training facilities and equipment, range and target requirements, training specialists and technical data.

transport

The means of conveyance to move forces, equipment, personnel and stocks and includes the requisite materials handling equipment.

transportation

The means of accomplishing the carriage of personnel or items from one place to another.

update

Modify the materiel hardware, software or firmware by changing its form and/or fit, but not its function or capability. Such change shall:

- a. employ the reference set of materiel standards;
- b. use the required codes of practice; and
- c. use the approved set of engineering change management procedures applicable to the product and its support products.

Note: Update applies to all support system elements such as tools, test equipment, test ranges, facilities and LIS etc.

upgrade

A change to the function of materiel hardware, software or firmware. It typically consists of the development and delivery of a new capability asset although it may consist of a:

- a. major change to an existing capability asset,
- b. minor changes to functionality, and
- c. disposal of the materiel at the end of its life of type (LOT).

upkeep

Sustainment activities completed on materiel to restore it to the specified product baseline (PBL) conformance level without any change. This includes periodic condition assessment, routine servicing, detection of non-conformances, corrective maintenance, pre-emptive servicing, restocking and rescheduling.

Note: Materiel includes the mission system and its support system, including equipment and all training suites, tools, test equipment, support consumables, spares and facilities.

ACRONYMS AND ABBREVIATIONS

ABL	allocated baseline
ADF	Australian Defence Force
ADO	Australian Defence Organisation
AIOS	acceptance into operational service
ALOC	air line of communication
AMC	alternative means of compliance
AMD	Australian Maritime Doctrine
AMOC	acceptable mean of compliance
AMPS	Asset Management and Planning System
AMSDO	Authorised Materiel Seaworthiness Delivery Organisation
C2	command and control
CC	capability coordinator
CDD	capability definition document
CDF	Chief of the Defence Force
CDLSA	Cooperative Defence Logistic Support Agreement
CFE	contractor furnished equipment
CI	configuration item
CIOG	Chief Information Officer Group
CIT	capability implementation team
CJOPS	Chief of Joint Operations
CLEO	Class Lifecycle Engineer Officer
CM	capability manager
CN	Chief of Navy
CO	commanding officer
COTS	commercial off-the-shelf
CRP	capability realisation plan

DCACA	data collection, analysis, and corrective action
DCN	Deputy Chief of Navy
DCP	Defence Capability Plan
DMSMS	diminishing manufacturing sources and material shortages
EO	explosive ordnance
EOD	explosive ordnance disposal
EPBC Act	Environmental Protection and Biodiversity Conservation Act – 1999
FBL	functional baseline
FE	force element
FELSA	front end logistics support analysis
FHQ	Fleet Headquarters
FIC	fundamental inputs to capability
FLSE	Fleet Logistic Support Element
FMEA	failure modes and effects analysis
FMECA	failure modes, effects and criticality analysis
FMS	foreign military sales
FPS	functional performance specification
FRACA	failure reporting and corrective action
HNE	Head Navy Engineering, Regulation, Certification and Safety
HQJOC	Headquarters Joint Operations Command
ICT	information and communications technology
IEM	inactive equipment maintenance
ILS	integrated logistic support

ILSP	integrated logistics support plan
IMR	initial materiel release
IOC	initial operational capability
IOR	initial operational release
IP	intellectual property
ISD	in-service date
ISS	in-service support
ITAR	International Traffic in Arms Regulations
JFIB	joint force-in-being
JMAP	joint military appreciation process
JTF	joint task force
LCCA	life cycle cost analysis
LIS	logistic information system
LORA	level of repair analysis
LOT	life-of-type
LOTS	logistics over-the-shore
LSA	logistic support analysis
LSE	Logistic Support Element
MAA	materiel acquisition agreement
MATCONOFF	materiel control officer
MILIS	Military Integrated Logistics Information System
MLSA	mutual logistics support arrangement
MOTS	military off-the-shelf
MSwFMS	Materiel Seaworthiness Functional Master Set
MSA	materiel sustainment agreement
MSAS	Materiel Seaworthiness Assurance System

MSD	Maritime Systems Division
MSMP	materiel seaworthiness management plan
MSTA	maintenance support task analysis
NAS	naval assurance system
NATO	North Atlantic Treaty Organisation
NAVSTRATCOM	Navy Strategic Command
NPOC	net personnel and operating costs
NSB	national support base
OCD	operational concept document
OEM	original equipment manufacturer
OR	operational release
OT&E	operational test and evaluation
OVP	operational viability period
PBL	product baseline
PdS	product schedule
PM	planned maintenance
POD	port of disembarkation
POE	port of embarkation
POL	petrol, oils and lubricants
R&D	research and development
RAM	reliability availability and maintainability
RAN	Royal Australian Navy
RAS	replenishment at sea
RCM	reliability centred maintenance
RI	repairable item
S&TE	support and test equipment

SLIMS	Ships Logistic Information Management System
SLOC	sea line of communication
SOI	statement of operating intent
SPOD	seaport of disembarkation
SPOE	seaport of embarkation
SSA	shared services agreement
SSTA	supply support task analysis
T&E	test and evaluation
TCD	test concept document
TGLC	task group logistic coordinator
TRA	technical regulatory authority
TRF	technical regulatory framework
U3	upgrade, upkeep, update
UMS	urgent materiel screening
UN	United Nations
UUC	usage upkeep cycle
VCDF	Vice Chief of the Defence Force
V&V	verification and validation



