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Integrated Logistics Support to Integrated Product Support

On the surface this transition does not appear to be too complex, however, the inclusion of product design and product management will drive a deeper investigation into how integrated product support will be better suited and adaptable to the new support engineering environment.

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EXECUTIVE SUMMARY

The aim of Integrated Logistic Support (ILS) has always been to maximise the operational availability of equipment at an optimal lifecycle cost. As a concept, all stakeholders see this aim as being sensible and completely logical. Designers should communicate with manufacturers, who should understand their supply chain capabilities, who in turn should understand the maintenance requirements etc. to achieve optimisation.

However, over the last decade there has been a noticeable decrease in the 'Integration' of all considerations in product development. This failing is most often characterised by less and less data exchange at every ILS cooperative boundary as items are designed, produced, used, maintained, repaired, and disposed. Less and less are we seeing the necessary ILS specialists communicating closely with one another leading to unnecessary waste throughout the entire product life cycle. Simply, the ILS engineer is not influencing the product design to make it less costly to support.

The re-framing of ILS to IPS aims to bring the focus back on the integration of all considerations which contribute to maximising the operational availability of equipment at an optimal lifecycle cost – the unwavering objective of ILS all along.

INTRODUCTION

The purpose of ILS is to influence system and component design (and integration) from a support perspective; this purpose does not change with the move to IPS. There are a few things that we must not forget. Primarily, ILS (and IPS) is a systems engineering activity within the 'by design' disciplines – what we are trying to achieve is supportable by design. Secondly, in the world of Commercial off The Shelf (COTS) systems or systems of systems, design influence is limited by the 'off the shelf' nature of the system components. However, the IPS engineer should be looking at Integration Influence – influencing the way the system is integrated from a support perspective.

INTEGRATED LOGISTICS SUPPORT BACKGROUND

ILS originated in the US Army in 1955 with Department of Defense (DoD) Directive 3232.1, which focused on readiness, support, and cost effectiveness. This focus has not changed with the advent of IPS. In 1964, DoD Directive 4100.035 was issued which expanded the scope and influence of the earlier Directive. The first real ILS Standard was MIL STD 1388-1 which was published in 1973; 1388-1A was published in 1983. UK Ministry of Defence (MOD) copied 1388 with Defence Standard (Def Stan) 00-60 in 1993. Unlike other Def Stans at the time, 00-60 was a complex contracting document, effectively providing instruction to commercial officers on how to contract for ILS packages or services. The period 2001 to 2010 saw the Def Stan 00-60 Working Group attempt to improve usability of the document and in 2010 Issue 1 of Def Stan 00-600 was published. Def Stan 00-600 realigned with other Def Stans, but the resultant document had removed much of the useful commercial information. Recognising the information gap, UK MOD released Joint Services Publication (JSP) 886 Defence Supply Chain Manual of which Volume 7 is dedicated to ILS. JSP886 is widely recognised by UK ILS practitioners as an excellent source of ILS information. In 2016, against a UK MOD background of JSP rationalisation, JSP886 was withdrawn. The Defence Logistic Framework (DLF) became primary UK MOD reference document in 2016.

The document sits in the Knowledge in Defence area of the Defence Equipment and Support intranet and can only be seen by UK MOD, unless industry is granted access. There are continuing discussions about the efficacy of DLF in terms of the ILS/IPS discipline.

MIL-STD-1388-1A Logistic Support Analysis was cancelled in May 1997.

Was superseded by MIL-HDBK 502 Acquisition Logistics, which was issued in May 1997

MIL-HDBK 502A Product Support Analysis (PSA) was issued in March 2013 to replace the earlier MIL-HDBK 502 and is current today.

In addition, today's MIL-HDBK 502A offers guidance on SAE TA-STD-0017 Product Support Analysis (See ASSIST Adoption Notice) and is supported by SAE TAHB-0007-1 Logistics Product Data Reports Handbook)

A key point to note in the evolution of 1388-1a is the transition of title from Logistic Support Analysis to Product Support Analysis under 502A.

Other standards of note – DEF(AUST) 5691 (LSA)/5692 (LSAR) [MIL STD 1388 in another guise].

INTEGRATED PRODUCT SUPPORT BACKGROUND

Over the past 20 years, the international aerospace and Defense community has invested considerable effort in the development of specifications in the field of IPS. The work was accomplished by integrated Working Groups (WG) composed of industry and customer organisations in a collaborative environment. Working group participants included representatives from national ministries and departments of Defense from Europe and the United States. Aerospace and Defense associations provided guidance and supported the work as required. The structure and functional coverage of these specifications was largely determined by North Atlantic Treaty Organisation (NATO) requirements specified during an international workshop in Paris in 1993.

Beginning in 2003, the relationships between supporting industry organisations were formalised through a series of Memoranda of Understanding (MOU). Initially, Aerospace Industries Association (AIA) and Aerospace, Security and Defence Industries Association of Europe (ASD) signed an MOU to jointly develop and maintain S1000D (International specification for technical publications using a common source database). In 2007, AIA, ASD and the Air Transport Association of America (ATA) signed a new MOU expanding S1000D development and maintenance to cover commercial aviation.

In 2010, AIA and ASD signed an MOU "to promote a common, interoperable, international suite of Integrated Logistics Support (ILS) specifications" and jointly develop, what was originally, the ASD suite of S-Series ILS specifications (later renamed to S-Series IPS specifications).

The 2010 AIA/ASD MOU authorised the formation of an ILS specifications Council (now IPS Council) with members from AIA and ASD. The Council's tasks include liaising between AIA and ASD, developing and maintaining the S-Series IPS specifications, administering joint meetings, and identifying additional areas of harmonisation. Multiple IPS specifications are currently available or are in the process of development.

From an Australian perspective IPS is defined as management methodology that enables the development, implementation and optimisation of an effective and affordable Support Solution, ensuring the Mission System is available to perform when required and is sustainable for the period required. In Defence, IPS is undertaken by IPS Practitioners, Managers and/or Directors.

IPS is an evolved Integrated Logistics Support. The primary objective of a support system role is to ensure preparedness, readiness and operational capability of the mission and support system, its subsystems and components in a timely and cost effective manner. IPS will help achieve Defence business outcomes by enabling speed to capability and where necessary, delivering a minimum viable support system.

THE IPS S SERIES SPECIFICATIONS ALIGNMENT

The development of the initial draft specifications is managed by WGs operating under the supervision of the IPS specification Council. Once approved for release, a specification's maintenance and future development is guided by a Steering Committee (SC), which also operates under guidance of the IPS Specification Council.

Development and maintenance of S1000D is accomplished through a separate ASD/AIA/ATA S1000D Council. Representatives from the S1000D Council and S1000D SC participate on the IPS Council as observers in order to achieve harmonisation between S1000D and other specifications from the S-Series IPS specifications.

INTEGRATED LOGISTICS SUPPORT

Integrated Logistics Support (ILS) and the 10 ILS Elements, refer Figure 1, had in some shape or form been DoD policy at least since the June 19, 1964 issuance of DoD Directive 4100.35 Development of Integrated Logistics Support for Systems and Equipment, although according to a 1975 research paper by then-Major (later General) George Babbitt entitled "An Historical Review of the Integrated Logistic Support Charter", Integrated Logistics Support had its roots as a precursor to today's Integrated Product Support in a November 3, 1955 DoD Directive 3232.1 DoD Maintenance Engineering Program. At a DoD level, ILS officially dated back more than 55 years to the 1964 DoD Directive 4100.35

The primary function of Integrated Logistics Support (ILS) Management in Defence is to acquire and optimise the in-service Support System, thereby ensuring the Mission System meets the ADF's preparedness requirements. ILS Management is conducted mainly in the Capability Support Dimension.

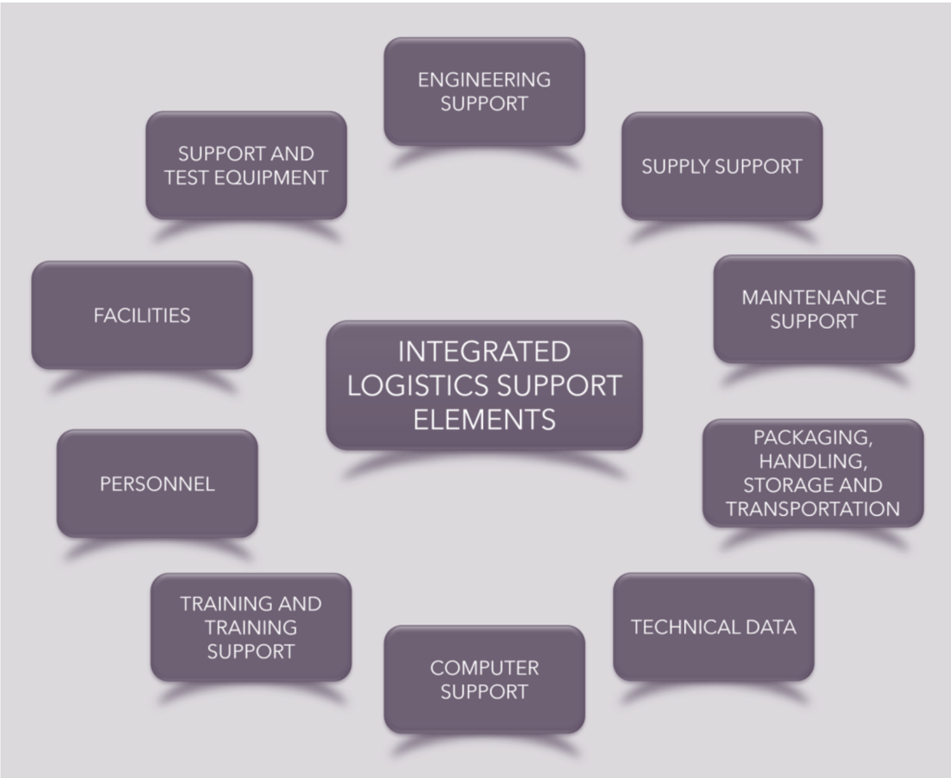


Figure 1 ILS Elements

ELEMENTS

The 10 ILS elements and their associated descriptions/information are:

Engineering Support (also referred to as Design Interface)

ILS activities encompass all of the considerations necessary to ensure that the required Engineering Support capability is implemented, maintained, and modified when required. These activities are undertaken to ensure that suitable engineering and design management services can be provided, as and when required, throughout the life of the Materiel System. The ILS discipline may utilise certain engineering services (e.g., maintenance requirements determination) to implement or change the Support System; however, ILS does not include the provision of day-to-day engineering services.

Supply Support

ILS activities encompass all the considerations necessary to ensure that the required Supply Support capability is implemented, maintained, and modified when required. These activities are undertaken to ensure that suitable supply services can be provided (e.g. warehousing services), as and when required, throughout the life of the Materiel System. The ILS discipline may utilise certain supply services (e.g. for the delivery of Support Resources) to implement or change the Support System; however, ILS does not include the provision of day-to-day supply services.

Maintenance Support (also referred to as Maintenance Planning)

ILS activities encompass all of the considerations necessary to ensure that the required Maintenance Support capability is implemented, maintained, and modified when required. These activities are undertaken to ensure that suitable maintenance services are able to be provided, as and when required, throughout the life of the Materiel System. The ILS discipline may utilise certain maintenance services (e.g. to incorporate modifications to equipment) to implement or change the Support System; however, ILS does not include the provision of day-to-day maintenance services.

Packaging, Handling, Storage and Transportation

ILS activities encompass all considerations necessary to enable Packaging, Handling, Storage and Transportation (PHS&T) resources and services to be provided so that a new or modified Materiel System is able to be operated and supported throughout its life. PHS&T services are managed and delivered through the Supply Support capability.

Technical Data (also referred to as Technical Publications/Documentation)

ILS activities encompass all of the considerations necessary to ensure that the appropriate data and information is competently managed and available, when, where and in the form required, for the operation, support, and disposal of the Mission System and Support System Components throughout the life of the Materiel System.

Computer Support (also referred to as Software Support)

ILS activities encompass all of the considerations necessary to ensure that the required Computer Support (Software Support) capability is implemented, maintained and modified when required. These activities are undertaken to ensure that suitable Software Support services, for embedded Mission System and Support System software and firmware, are able to be provided, as and when required, throughout the life of the Materiel System. Software Support services are managed and delivered through the Engineering Support capability. It also includes Logistic Information Management Systems (LIMS).

Training & Training Support

ILS activities encompass all of the considerations necessary to ensure that the required Training Support capability is implemented, maintained, and modified when required. These activities are undertaken to ensure that suitable training services can be provided, as and when required, throughout the life of the Materiel System. The ILS discipline may utilise certain training services (e.g. for the delivery of initial and/or conversion training) to implement or change the Support System; however, ILS does not include the provision of day-to-day training services.

Personnel (also referred as Manpower)

ILS activities encompass all of the considerations necessary to ensure that defence and/or contractor personnel are available, when, where and with the skills needed, to operate, maintain, train, store, handle, control, supply, project manage and dispose of the Mission System and Support System components throughout the life of the Materiel System.

Facilities

ILS activities encompass all of the considerations necessary to ensure that the facilities needed for the operation, support, and disposal of the Mission System and Support System Components, are provided throughout the life of the Materiel System

Support and Test Equipment (also referred to as Support Equipment)

ILS activities encompass all of the considerations necessary to ensure that the S&TE needed for the operation, support, and disposal of the Mission System and Support System components is provided, as and when required, throughout the life of the Materiel System.

INTERFACE WITH PROJECT CONTROLS

In addition, ILS interfaces with, but not limited to:

- Project Management
- Procurement Management
- Risk Management
- Inventory Management
- Supply Chain Management
- Safety and Hazard Analysis
- Human Factors Analysis
- Trials and Acceptance
- Configuration Management
- Quality
- Environmental Requirements
- Design Reviews
- Contract Management

SUMMARY

ILS includes many activities to ensure that Supportability objectives are achieved, while minimising LCC and complying with other constraints. The range of ILS activities to achieve these objectives includes management, analysis, and assessment activities to define, plan, implement, verify, validate, manage, maintain, change and dispose of the Support Resources that are categorised under the various Support Elements. The interaction between the ILS discipline, related disciplines, and the Support Elements as illustrated above. The inner circle of the above depicts ILS Management activities as a central function of planning and coordination across the range of interfaces and activities identified within the larger circle, including Supportability Analysis and Supportability Assessment activities. This inner circle represents Through-Life Support (TLS) disciplines, which is a whole-of-life management methodology that takes an integrated approach to all aspects of supportability and readiness of a materiel capability or system.

INTEGRATED PRODUCT SUPPORT

At first glance, the two lists appear to be quite similar, but in reality, both the elements themselves, what they include, and even how they are defined, are quite different -- hence the sunsetting of the ILS terminology in favour of a broader product support-focused IPS term. So what is different? First off, the two new elements are "Product Support Management" and "Sustaining Engineering." Both include an extensive life cycle management focus, and both include activities and aspects that extend across the life cycle and often beyond the traditional logistics domain.

In addition, the Maintenance Planning element expands to include Maintenance Management, again including O&S execution responsibilities. Infrastructure has been added to Facilities Element, expanding the breadth beyond what some saw were primarily focused on "brick and mortar" buildings. Computer Resources Support simply became Computer Resources, focused on supporting hardware and software, as well as support services necessary to ensure effective and affordable product support.

The operative word and common thread between ILS and IPS Elements is "Integrated." Regardless of how many there are, or exactly how each is defined, in order to design, develop, deploy, and sustain an affordable, effective system support strategy, the elements of that support must be integrated.

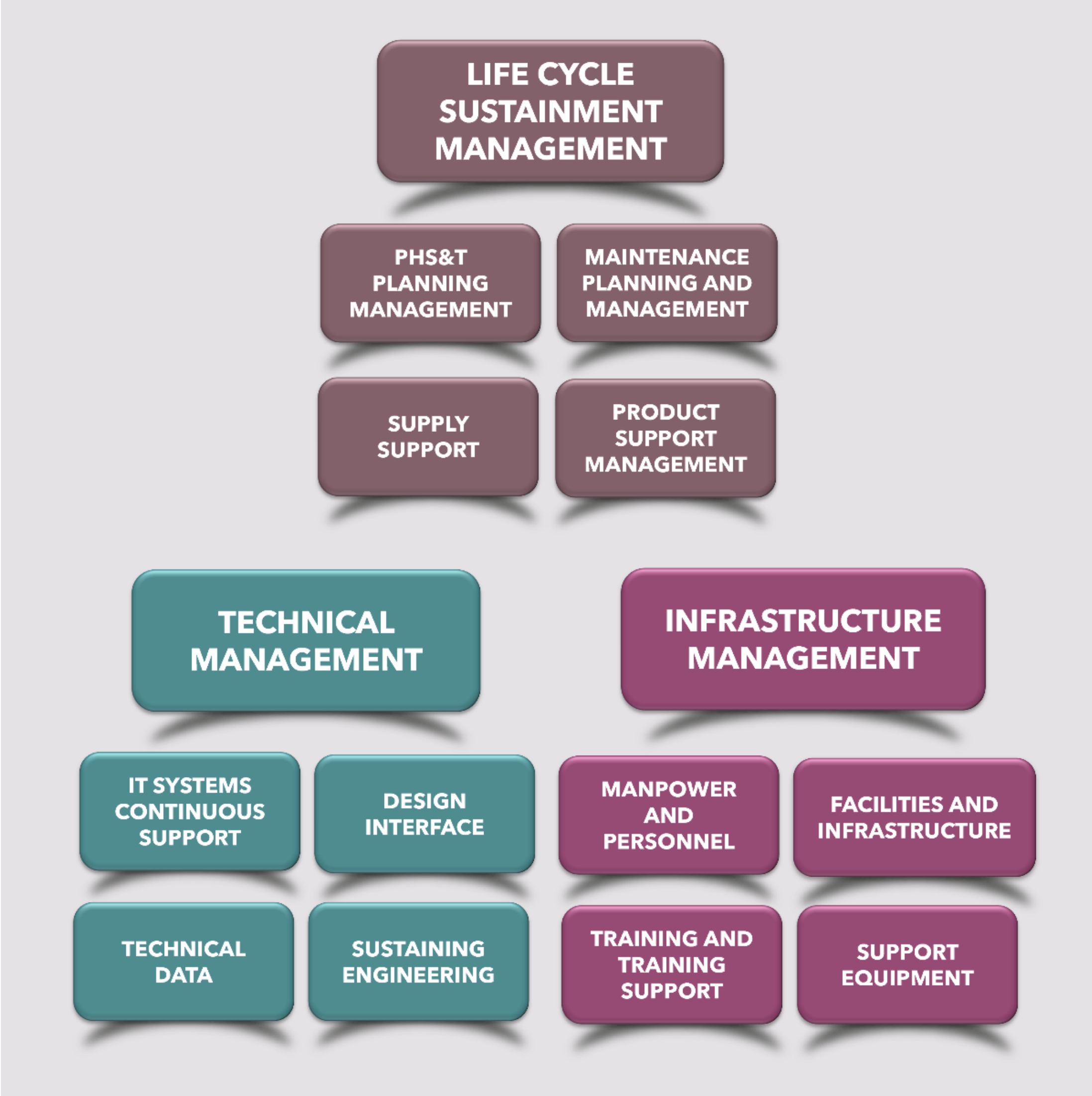


Figure 2 IPS Elements - Categorised

ELEMENTS

Whilst the categories defined in Figure 2, provide a breakdown of the elements into pseudo-functional groups these aren't fixed. These groups serve to identify how the elements impact the relevant areas. The 12 IPS elements and their associated descriptions are detailed as follows and listed individually in no particular order.

Product Support Management

Description

Product support management is the development and implementation of product support strategies to ensure supportability is considered throughout the system life cycle through the optimisation of the key performance outcomes of reliability, availability, maintainability, and reduction of total ownership costs.

Overview

This Product Support Management Integrated Product Support Element will, through the Product Support Manager, provide continuous product support leadership throughout the weapon system's life cycle, reporting to senior leadership of status of program key metrics and product support activities, and providing senior program subject matter expertise in all areas of life cycle product support.

The scope of product support management planning and execution includes the enterprise level integration of all twelve integrated product support elements throughout the lifecycle commensurate with the roles and responsibilities of the Product Support Manager position.

Importance

Product Support Managers develop, plan, and implement a comprehensive product support strategy for all integrated product support elements and their material readiness. Product support managers will make use of data-driven decision-making tools with appropriate predictive analysis capabilities to improve systems availability and reduce costs.

The Product Support Manager will need to understand requirements development, all Acquisition Phases and have a good working knowledge of other functional areas for planning and implementation activities, to include contracting, finance, configuration management, outcome-based strategy development, etc. for total life cycle product support of the weapon system being fielded.

Design Interface

Description

Design interface is the integration of the quantitative design characteristics of systems engineering (reliability, maintainability, etc.) with the functional Integrated Product Support Elements (i.e., Integrated Product Support Elements). Design interface reflects the driving relationship of system design parameters to product support resource requirements. These design parameters are expressed in operational terms rather than as inherent values and specifically relate to system requirements. Thus, product support requirements are derived to ensure the system meets its availability goals and design costs and support costs of the system are effectively balanced. The basic items that need to be considered as part of design interface include:

- Reliability
- Availability
- Maintainability
- Supportability
- Suitability
- Integrated Product Support (IPS) Elements
- Affordability
- Configuration Management
- Safety requirements
- Environmental and Hazardous Materials requirements
- Human Systems Integration
- Calibration
- Anti-Tamper
- Habitability
- Disposal
- Legal requirements

Overview

Design interface is intended to be a set of activities to control and manage design choices that impact supportability. Special test equipment could be controlled by limiting the introduction of new test equipment or limiting the design of the test equipment to fit within the existing support infrastructure training, facilities, supply support, etc., for test equipment. The inclusion of product support objectives into the management of design will greatly increase the probability that product support objectives are met in suitable and effective ways.

Importance

The activities of design interface begin during requirements definition of the system and continue throughout the system's life cycle. In each stage of the acquisition process, Life Cycle Logisticians will work as part of the Product Support Management Integrated Product Team with design and systems engineering, cost analysis, test and evaluation, quality control and many other program areas to ensure every aspect of the system is focused on meeting the required product support objectives.

Design interface is therefore a "leading activity" that impacts all the product support elements because a well performed design interface is one that minimises the logistics footprint, maximises reliability, ensures that maintainability is user friendly and effective, and addresses the long-term issues related to obsolescence management, technology refreshment, modifications and upgrades, and overall usage under all operating conditions.

The success of design interface is completely dependent upon the entire program leadership recognising that supportability goals must be achieved. A forward-looking culture needs to be encouraged throughout the program that the end products must be as easy to use and maintain as possible.

Sustaining Engineering

Description

Sustaining engineering spans those technical tasks (engineering and logistics investigations and analyses) to ensure continued operation and maintenance of a system with managed (i.e., known) risk. Sustaining engineering involves the identification, review, assessment, and resolution of deficiencies throughout a system's lifecycle.

Sustaining engineering returns a system to its baseline configuration and capability and identifies opportunities for performance and capability enhancement. It includes the measurement, identification and verification of system technical and supportability deficiencies, associated root cause analyses, evaluation of the potential for deficiency correction and the development of a range of corrective action options. Typically, Business Cases Analysis (BCA) and/or life-cycle economic analysis are performed to determine the relative costs and risks associated with the implementation of various corrective action options. Sustaining engineering also includes the implementation of selected corrective actions to include configuration or maintenance processes and the monitoring of sustainment health metrics. This includes:

- Collection and triage of all service use and maintenance data;
- Analysis of safety hazards, failure causes and effects, reliability and maintainability trends, and operational usage profiles changes;
- Root cause analysis of in-service problems (including operational hazards, deficiency reports, parts obsolescence, corrosion effects, and reliability degradation);
- The development of required design changes to resolve operational issues; and
- Other activities necessary to ensure cost-effective support to achieve peacetime and wartime readiness and performance requirements over a system's lifecycle.

Technical surveillance of critical safety items, approved sources for these items, and the oversight of the design configuration baselines (basic design engineering responsibility for the overall configuration including design packages, maintenance procedures, and usage profiles) for the fielded system to ensure continued certification compliance are also part of the sustaining engineering effort. Periodic technical review of the in-service system performance against baseline requirements, analysis of trends, and development of management options and resource requirements for resolution of operational issues should be part of the sustaining effort.

Overview

Sustaining engineering consists of a combination of systems engineering and product support life-cycle management strategies to achieve the desired sustainment metric outcomes for the program. The focus is on understanding the cost and logistics infrastructure and footprint associated with meeting the Customer/stakeholder requirements and the process to track, control and/or reduce the need for product support over the life cycle of the weapon system.

Historically, Sustaining Engineering activities were the primary responsibility of engineering and product development, with Sustaining Engineering activities conducted during Operations & Support being planned and implemented often under separate contract line items and separate management. The current view of integrated product support requires that the Life Cycle Sustainment Plan include and implement an integrated strategy, inclusive of all the Product Support Elements and Program functional areas, that is reviewed and reported on throughout the acquisition life cycle.

Sustaining Engineering is a shared area of responsibilities between Logistics and Engineering. It provides the framework for the support of the in-service Mission and Support Systems (Materiel System) in their operational environment. It focuses on engineering activities specifically related to ensuring no degradation of the technical performance of the Materiel System over its life cycle. It returns a Mission System to kits baseline configuration and capability, while identifying opportunities for performance and capability enhancements.

For example, root cause analysis of in-service problems (including operational hazards, deficiency reports, parts obsolescence, corrosion effects, and reliability degradation) often results in recommendations for design changes to eliminate components requiring frequent maintenance; minimise or eliminate maintenance tasks; maximise commonality with existing infrastructure such as type of fuel, available support equipment, etc. and allow greater modularity for upgrades.

Importance

Once the weapon system is fielded, achieving the support concept, and sustaining operational capability requires the involvement of the logistics, engineering, testing, program management, contracts, supply chain, and financial management experts. The overall product support strategy, documented in the Life-Cycle Sustainment Plan (LCSP)/Product Support Strategy, should include life-cycle support planning and address actions to assure long-term sustainment and continually improve product affordability for programs in initial procurement, re-procurement, and post-production support. A performance-based product support process will be used to align the support activities necessary to meet these objectives.

In today's world with the fast pace of technology, process, and skill-based changes, a continuous challenge to improve, upgrade, prevent or simply refresh the technical foundations of a weapon system confronts the Project Manager/Product Support Manager. The sum of the technical activities (primarily maintenance and activities typically aligned to systems engineering areas), along with supporting activities such as financial, supply chain, etc., necessary to ensure the weapon system continues to meet user requirements and program Key Performance Parameter (KPP)/ Key System Attributes (KSA) is known as Sustaining Engineering.

Supply Support

Description

Supply support consists of all management actions, procedures, and techniques necessary to determine requirements to acquire, catalogue, receive, store, transfer, issue and dispose of spares, repair parts, and supplies. This means having the right spares, repair parts, and all classes of supplies available, in the right quantities, at the right place, at the right time, at the right price. The process includes provisioning for initial support, as well as acquiring, distributing, and replenishing inventories.

Overview

DoD Supply Support provides effective and efficient end-to-end customer service to meet operational requirements for all classes of supply. To supply materiel to DoD units throughout the world, the DoD Components and Agencies maintain a supply chain consisting of weapon system support contractors, retail supply activities, distribution depots, transportation channels including contracted carriers, wholesale Integrated Materiel Managers (IMM), weapon system product support integrators, commercial distributors and suppliers including manufacturers, commercial and organic maintenance facilities, and other logistics activities (e.g., engineering support activities, testing facilities, reutilisation and marketing offices).

While the focus of supply support is on the provisioning and delivery of repair parts, it is a major area within the field of supply chain management. Supply chain management integrates sustaining engineering, maintenance, PHS&T, support equipment and technical data. The system's supply chain is an integrated network that extends from the supplier's supplier to the customer's customer and back through a return cycle. For example, a poor provisioning list will result in either missing or incorrect spare parts being procured, stored and delivered to the customer/stakeholder.

Missing or incorrect parts result in higher equipment downtime, higher costs for procuring the wrong item, and higher maintenance failure rates if the wrong, or a counterfeit, part is installed on the Mission System. In some cases, a defective component can result in system failure causing loss of life.

Historically, Supply Support activities were the primary responsibility of the manufacturing group, with Supply Support during sustainment being planned and implemented often under separate contract line items and separate management. The current view of integrated product support requires that the Life Cycle Sustainment Plan include and implement an integrated strategy, inclusive of all the Product Support Elements and Program functional areas, that is reviewed and reported on throughout the acquisition life cycle.

Importance

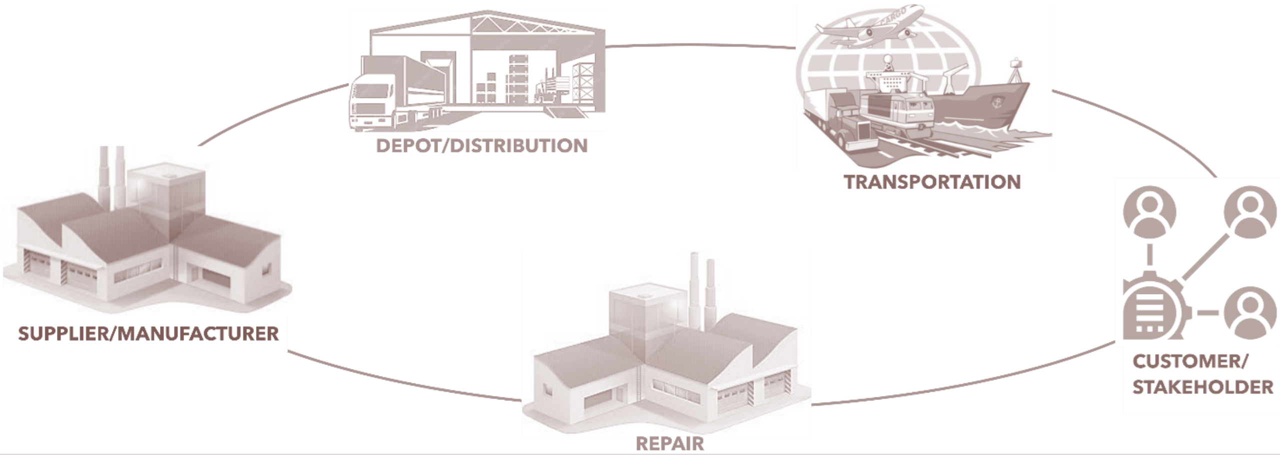
Support extends across the DoD logistics enterprise. The DoD logistics enterprise encompasses global logistics capabilities provided by Combatant Commands, Military Services, Defense Agencies, designated process owners, the national industrial base, non Defense U.S.

Government agencies, multinational governments and military forces, non-governmental organisations, and both domestic and international commercial partners.

Understanding, clarifying, and institutionalising the diverse roles, relationships, and responsibilities of all these enterprise partners are essential to planning, executing, controlling, and assessing logistics enterprise operations. Enterprise partners, stakeholders, and process owners must collaborate to optimise use of resources and capabilities from all available sources and to integrate and synchronise logistics processes to support the customer/stakeholder.

A Supply Chain Management (SCM) strategy addressing all stakeholders is critical to the success of any Performance Based Life Cycle Product Support (PBL) effort. Materiel support is a critical link in weapons systems supportability. All the skilled labour, advanced technology, and performance mean little without the "right part, in the right place, at the right time." The supply chain is also a primary venue for utilising industry flexibility, capability, and proprietary spares support.

The interfaces or "touch points" between and among all the stakeholder organizations with the program's supply chain must be identified and understood in order to determine how best to manage each part of the supply chain and what the impacts of decisions might be.



INTERFACE	IMPACT
Inventory and transportation planning	• Inventory positioning decisions • higher transportation costs • longer customer wait times
DoD logistics IT systems	• lack of information exchange • little visibility into assets
Repair capacity and new inventory procurement	• higher material costs - buying new instead of fixing old
Maintenance planning and technical data/RBOMs	• depot inefficiencies - consumables are not available when needed
Collaboration between supplier and customer in predicting demand	• demand plan accuracy not uniformly captured • lack of necessary parts • longer customer wait times
Customer wait time information not always captured at each node	• internal processes contributing to customer wait times - without nodal data it is difficult to drive focussed improvement • higher inventory requirements - high customer wait times leads to higher safety stock requirements
DoD supply chain not fully leveraged	• based on historical performance, DoD losing sales opportunities needed to take full advantage of economies of scale.

Figure 2 IPS Elements – Categorised

Maintenance Planning and Management

Description

Maintenance planning and management establishes maintenance concepts and requirements for the life of the system, for hardware and software, including:

- Levels of repair
- Repair times
- Testability requirements
- Support equipment needs
- Training and Training Aids Devices Simulators and Simulations (TADSS)
- Manpower skills

- Facilities
- Inter-service, organic and contractor mix of repair responsibility
- Deployment Planning/Site activation
- Development of preventive maintenance programs using reliability centered maintenance
- Condition Based Maintenance Plus (CBM+)
- Diagnostics/Prognostics and Health Management
- Sustainment
- PBL planning
- Post-production software support.

Overview

Maintenance planning and management is the development process that defines the repair and upkeep tasks, schedule, and resources required to care for and sustain a weapons system with the focus being to define the actions and support necessary to attain the system's Operational Availability (Ao) objective. It is considered part of the Life Cycle Sustainment Plan (LCSP)/Product Support Strategy development starting as early as the Technology Maturation and Risk Reduction Phase in the system's life-cycle. It includes the identification of all the manpower and funding resources required to develop and implement the maintenance and modernisation plan.

Maintenance planning and management is the prevention or correction of Mission System failure or the failure of its support equipment. The ultimate goal of the Materiel Logistician is to influence design to minimise or eliminate the need for maintenance on the Mission System. For those maintenance actions that cannot be eliminated, the next priority is to implement preventative or condition based maintenance and operator training to minimise the type, severity and cost for maintenance procedures. For example, a new engine of a high performance aircraft has been designed that requires depot level skills and specialised support equipment. The Materiel Logistician may be able to influence design to develop engine diagnostic equipment that can be run at the organic level of maintenance to check on engine performance, thus reducing the frequency of returning the engine to the depot for major service work

Importance

Maintenance planning and management activities are heavily influenced prior to system deployment by the design interface activities which focus on ensuring that the program's Key Performance Indicators are achieved through design that is focused on optimising availability and reliability at reduced life cycle cost. After deployment and during Operations and Sustainment (O&S), the activities of sustaining engineering (including product improvement, reliability fixes, continuing process improvements and technology refresh) continue those of design interface and integrate both back with engineering and manufacturing activities and forward to collect and validate system operational performance with the user. The Product Support Manager is thus capable of implementing a total enterprise sustainment strategy.

Seeking to prevent, reduce and improve maintenance actions will have a direct impact on both availability outcomes and reduction of life cycle costs. There are many avenues to improve or prevent maintenance and many reasons why.

Historically, maintenance planning and management activities were the primary responsibility of engineering and product development, with maintenance execution activities being planned and implemented often under separate contract line items.

Packaging, Handling, Storage and Transportation Planning & Management

Description

PHS&T is the combination of resources, processes, procedures, design considerations, and methods to ensure that all system, equipment, and support items are preserved, packaged, handled, and transported properly, including environmental considerations, equipment preservation for the short and long storage, and transportability. Some items require special environmentally controlled, shock isolated containers for transport to and from repair and storage facilities via all modes of transportation (land, rail, air, and sea).

Overview

PHS&T addresses these four functional areas:

- **Packaging**: provides for product security, transportability, storability. The nature of an item determines the type and extent of protection needed to prevent its deterioration, physical and mechanical damage. Shipping and handling, as well as the length and type of storage considerations, dictate cleaning processes, preservatives, and packaging materials.
- **Handling**: involves the moving of materiel from one place to another within a limited range and is normally confined to a single area, such as between warehouses, storage areas, or operational locations, underway replenishment, shipboard cargo holds, aircraft, or movement from storage to the mode of transportation.
- **Storage**: infers the short or long term storing of items. Storage can be accomplished in either temporary or permanent facilities of varying conditions, i.e., general purpose, humidity-controlled warehouses, refrigerated storage and shipboard.
- **Transportation**: the movement of equipment and supplies using standard modes of transportation for shipment by land, air, and sea. Modes of transportation include cargo, vehicle, rail, ship, and aircraft.

Packaging, Handling, Storage and Transportation (PHS&T) focuses on the unique requirements involved with packaging, handling, storing, and transporting not only the major end items of the weapon system but also spare parts, other classes of supply and infrastructure items. The requirements and constraints which a military environment imposes on these activities can significantly affect availability, reliability, and life cycle costs of the weapon system.

Examples of unique military requirements include storage of materiel in extreme environments for long periods of time, transport into and out of remote regions where commercial carriers are not present, international customs and inspection requirements, and the routine shipping of dangerous and hazardous items.

These unique requirements are high value opportunities to use the benefits of IPS Element integration to minimise risk and cost associated with these areas. Specific examples include. Designing an item, such as a battery, for a longer shelf life to minimise risk of the war fighter receiving an inoperable product; designing to remove hazardous materials or components to eliminate the need for special transportation requirements, often hazardous items cannot be carried on a cargo aircraft but must be transported via surface ground or sea, thus increasing the time for delivery; and incorporating innovating radio frequency identification technology to reduce risk of item loss or delay during shipping and storage.

Importance

PHS&T processes are essential components of effective Supply Chain Management. An efficient PHS&T system introduces minimal procurement delays or errors, and results in material shipments at the "right place at the right time," thus improving system availability and lowering overall life cycle cost. Typically, a PHS&T system will include elements of total asset visibility.

The outcomes of PHS&T activities not properly being addressed directly impact the Key Performance Parameter of Availability and life cycle cost management in several ways, for example:

- Transportation problems where items are delayed, or more significantly, cannot be shipped due to physical or regulatory restrictions
- Storage issues where shelf-life has expired, or improper storage has caused degradation of the product
- Poor packaging or marking resulted in lost items during shipping
- Incorrect handling resulted in damage to the item being shipped.

Since all items, even software data, are subject to PHS&T requirements and considerations. The Product Support Manager must ensure that PHS&T is given thorough consideration starting early in the design process. Historically, PHS&T activities were the primary responsibility of the manufacturers, with PHS&T sustainment being planned and implemented often under separate contract line items and separate management.

Technical Data

Description

Technical Data represents recorded information of a scientific or technical nature, regardless of form or character (such as equipment technical manuals and engineering drawings), engineering data, specifications, standards, and Data Item Descriptions (DID).

Technical Manuals (TM), including Interactive Electronic Technical Manuals/Publications (IETM/P) and engineering drawings, are the most expensive and probably the most important data acquisitions made in support of a system. TMs and IETM/Ps provide the instructions for operation and maintenance of a system. IETM/Ps also provide integrated training and diagnostic fault isolation procedures.

Technical data addresses data rights and data delivery as well as use of any proprietary data as part of this element. A data management system established within the Integrated Digital Environment can allow every activity involved with the program to cost-effectively create, store, access, manipulate, and exchange digital data.

Technical data includes, at minimum, the data management needs of the SE process, modelling and simulation activities, test and evaluation strategy, support strategy, and other periodic reporting requirements. It also includes as-maintained bills of material and system configuration by individual system identification code or "tail number."

Overview

Technical Data is recorded forms of information of a scientific or technical nature pertaining to products sold to the government. Product specifications, engineering drawings, and operating or maintenance manuals are examples of technical data. The term does not include computer software or financial, administrative, cost, pricing, or other management data.

Technical data describes product, interfaces, and decisions made ensuring it:

- is traceable, responsive to changes, and consistent with configuration management requirements
- is prepared and stored digitally
- involves deciding what data is needed, who shall control it, and when.

There are three recognised primary categories of data:

- management data
- computer software
- financial information.

Management Data is data related to planning, organising, and managing the project.

Computer software documentation is a part of technical data management and is differentiated from the data category of "Computer Software." Computer software documentation refers to owner manuals, user manuals, installation instructions, operating instructions, and other similar documents, regardless of storage medium, that explain the capabilities of the computer software or provide instructions for using the software.

Financial management and contract administration include contract numbers, payment due dates, contract payment terms, employee travel expenses, and contractor revenue.

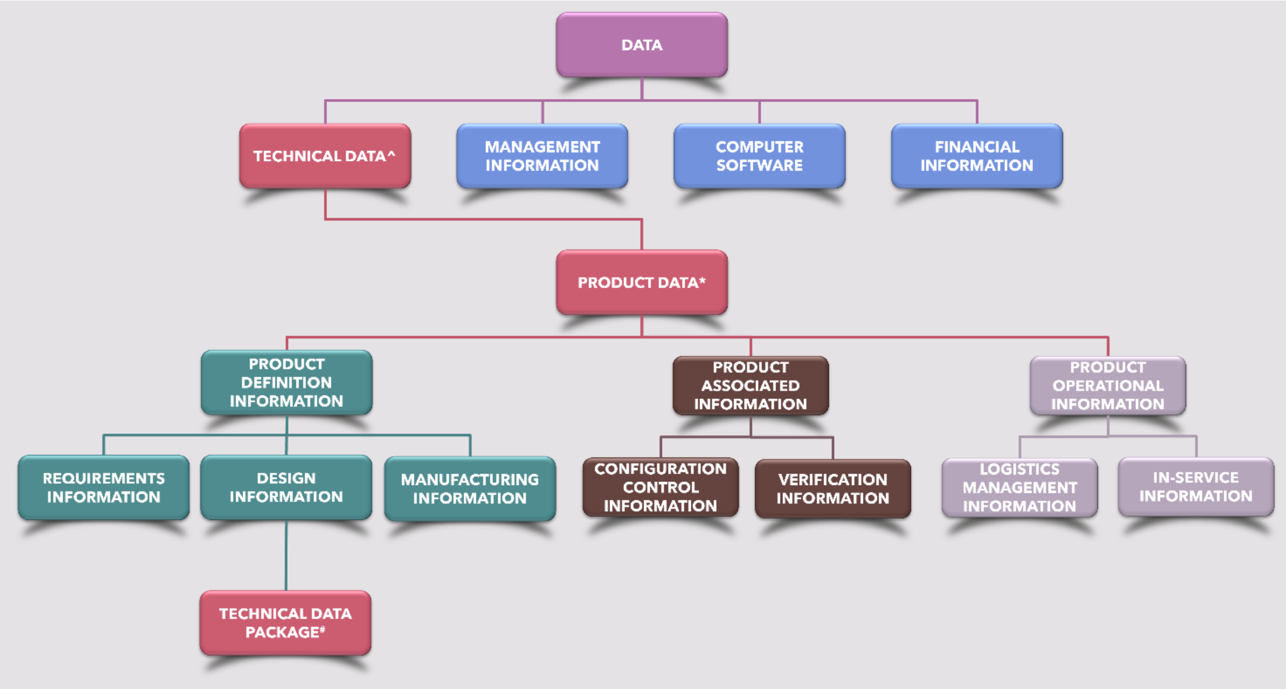


Figure 3 Data Organisationally Structured

^Technical Data: Recorded information, regardless of the form or method of the recording of a scientific or technical nature (including computer software documentation). The term does not include computer software or data incidental to contract administration such as financial or management information.

*Product Data: All data created as a consequence of defining (requirements), designing, testing, producing, packing, storing, operating, maintaining, modifying and disposing of a product.

#Technical Data Package: A technical description of an item adequate for supporting an acquisition strategy, production, engineering and logistics support. The description defines the required design configuration or performance requirements and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as:

- drawings/models
- lists – inspection/test equipment
- specifications, standards
- performance requirements
- quality assurance requirements
- software documentation
- interface control documents
- engineering product structure
- packaging details.

Product Data includes these three sub-categories:

1. Product Definition information - information that defines the product's requirements documents the product's design and manufacturing. This is the authoritative source for configuration definition and control. Examples include drawings, 3D CAD models, and trade studies.
2. Product Operational information - information used to operate, maintain, and dispose of the product. Examples include records of maintenance actions, technical manuals, and transportation information, and depot overhaul information.
3. Product Associated information - other product data such as test results, software or binary code embedded on memory chips, and proposed configuration changes that do not fit clearly into the other categories. This information is in the form of a living document that records the modifications, upgrades, and changes over the lifecycle.

The technical data product support element includes the processes of applying policies, systems and procedures for identification and control of data requirements; for the timely and economical acquisition of such data; for assuring the adequacy of data for its intended use; for the distribution or communication of the data to the point of use; and for use analysis.

Technical data activities document and maintain the database reflecting system life cycle decisions, methods, feedback, metrics, and configuration control. It directly supports the configuration status accounting process. Technical data processes govern and control the selection, generation, preparation, acquisition, and use of data imposed on contractors.

Procedures for the Acquisition and Management of Technical Data, data acquisition and management is the process of applying policies, systems, and procedures for:

- Identification and control of data requirements
- Timely and economic development of data
- Ensuring the adequacy of such data for full compliance with the contract and for its intended use. This includes, where necessary, early application of contractual remedies needed to correct defective data products.
- Distribution of the data to the point of use
- Analysis of the data's suitability for intended use.

Importance

Product support managers will make use of data-driven decision making tools with appropriate predictive analysis capabilities to improve systems availability and reduce costs; Program Managers will consider the procurement of data deliverables and associated license rights needed to support competitive acquisition and life-cycle sustainment strategies.

If affordable, ownership of full data rights is beneficial. But the Product Support Manager must consider the spectrum of alternatives available for data access, which can include ownership, option to buy ownership, leasing agreements, or access by way of a public-private partnership. There are choices that exist between the acquire or not-acquire decision.

In accordance with Military Standard (MIL-STD)-31000, for acquisition, upgrades, and management of technical data provide:

- Information necessary to understand and evaluate system designs throughout the life cycle
- Ability to operate and sustain weapon systems under a variety of changing technical, operational, and programmatic environments
- Ability to re-compete item acquisition, upgrades, and sustainment activities in the interest of achieving cost savings; the lack of technical data and/or data rights often makes it difficult or impossible to award contracts to anyone other than the original manufacturer, thereby taking away much or all of the Government's ability to reduce total ownership costs (TOC).

Technical data is the "knowledge products" of the acquisition process, as well as the sustainment process. It is the basis for most, if not all acquisition, design, development, production, operation, support, and maintenance decision-making. Being able to access the right data at the right time to make the right decisions does not happen by chance. Good data management also does not happen as a result of ordering excessive data, just in case. Rather, effective technical data strategy implementation is the product of an effective data management process.

Support Equipment

Description

Support equipment consists of all equipment (mobile or fixed) required to support the operation and maintenance of a system. This includes but is not limited to ground handling and maintenance equipment, trucks, air conditioners, generators, tools, metrology and calibration equipment, and manual and automatic test equipment. During the acquisition of systems, PMs are expected to decrease the proliferation of support equipment into the inventory by minimising the development of new support equipment and giving more attention to the use of existing Government or commercial equipment.

Overview

Items that are required to support the operation or maintenance of a system are called support equipment. Support Equipment can be mobile or fixed but is not an integral part of the system. However, support equipment is not only for maintenance. Material handling equipment is used in storage facilities and computers are necessary for support personnel to perform their jobs.

Support equipment categories include:

- Ground support equipment
- Materials handling equipment
- Tool kits and tool sets
- Metrology and calibration devices
- Automated test systems (includes BITE, TMDE, ATE, TPS, General Purpose Electronic Test Equipment, Special Purpose Electronic Test Equipment)
- Support equipment for on-equipment maintenance and off-equipment maintenance
- Special inspection equipment and depot maintenance plant equipment

- Industrial plant equipment
- Ammunition support equipment
- Medical/life support equipment
- Support equipment for the individual, i.e., soldier, pilot, special operations.

Support and test equipment can be segmented into "common" and "peculiar" categories.

Common Support Equipment (CSE) includes items that are currently in the DoD inventory and are applicable to multiple systems. Because CSE is already in the DoD inventory, its technical documentation, support requirements, provisioning records and maintenance requirements are catalogued as part of the federal logistics information system.

Peculiar Support Equipment (PSE) includes items that are unique to the system and have no other application in DoD. PSE requires development of technical documentation in federal cataloging records. PSE will require support; support that is currently not available in the DoD system but will have to be developed concurrently with development of the major systems.

Importance

The Support Equipment product support element is critical to ensuring that weapon systems are well maintained and properly calibrated in order to support the readiness and operational availability of the system and to meet the customer/stakeholder's needs. Support Equipment is important to understand because each piece of equipment may represent its own "mini-acquisition" process within the weapon system program.

One goal of the Product Support Manager is to minimise or eliminate support equipment through design influence or technology refresh. For that support equipment to be necessary for operations and sustainment, the Product Support Manager must ensure that it meets all the criteria of human systems integration, reliability, availability, cost optimisation, and that overall it "makes sense" on how and where it is used. When support equipment is required, CSE is the preferred source.

Historically, Support Equipment activities have been the primary responsibility of engineering and product development, with resulting logistics activities being planned and implemented often under separate contract line items. The current view of integrated product support requires that the Life Cycle Sustainment Plan/Product Support Strategy include and implement an integrated strategy, inclusive of all the Product Support Elements, that is reviewed and reported on throughout the acquisition life cycle.

The current view represents support equipment activities being heavily influenced prior to system deployment by the design interface activities which focus on ensuring that the program KPP's are achieved through design to optimise availability and reliability at reduced life cycle cost. After deployment and during Operations and Sustainment (O&S), the activities of sustaining engineering (including product improvement, reliability fixes, continuing process improvements and technology refresh) continue those of design influence and integrate both back with engineering and manufacturing activities and forward to collect and validate system operational performance with the user. The Product Support Manager is thus capable of implementing a total enterprise sustainment strategy inclusive of all acquisition phases and all product support element scopes.

Training and Training Support

Description

Training and training support consist of the policy, processes, procedures, techniques, Training Aids, Devices, Simulators, and Simulations (TADSS), planning and provisioning for the training base including equipment used to train civilian and military personnel to acquire, operate, maintain, and support a system.

This includes New Equipment Training (NET), institutional, sustainment training and Displaced Equipment Training (DET) for the individual, crew, unit, collective, and maintenance through initial, formal, informal, On-the-Job Training (OJT), and sustainment proficiency training. Significant efforts are focused on NET which in conjunction with the overall training strategy is validated during system evaluation and test at the individual-, crew-, and unit-levels.

Overview

Training is the learning process by which personnel individually or collectively acquire or enhance pre-determined job-relevant knowledge, skills, and abilities by developing their cognitive, physical, sensory, and team dynamic abilities.

The "training/instructional system" integrates training concepts and strategies and elements of logistic support to satisfy personnel performance levels required to operate, maintain, and support the systems. It includes the tools used to provide learning experiences such as computer-based interactive courseware, simulators, and actual equipment (including embedded training capabilities on actual equipment), job performance aids, and Interactive Electronic Technical Manuals (IETM).

It is critical that to ensure alignment between system design and training program, any and all changes must be evaluated as to the impact on the training program. The training products themselves may require separate configuration management and supportability.

Importance

Training gives users, operators, maintainers, leaders, and support personnel the opportunity to acquire, gain, or enhance knowledge and skills, and concurrently develop their cognitive, physical, sensory, team dynamics, and adaptive abilities to conduct joint operations and achieve maximised and fiscally sustainable system life cycles. The training of people as a component of material solutions delivers the intended capability to improve or fill capability gaps.

Cost-and mission-effective training facilitates DoD acquisition policy that requires optimised total system performance and minimises the cost of ownership through a "total system approach" to acquisition management. The systems engineering concept of a purposely designed ‘total system’ includes not only the mission system equipment, but, more critically, the people who operate, maintain, lead, and support these acquired systems -- including the training, training systems, and the operational and support infrastructure.

The goal of training for new systems is to develop and sustain a ready, well-trained individual/unit, while considering options that can reduce life-cycle costs and provide positive contributions to the joint context of a system and provide positive readiness outcomes.

The Product Support Manager needs to understand the requirements for training related to the civilian and military workforce for weapon systems acquisition and the training required for civilians and military to lead, operate and sustainment the weapon system being fielded.

Training performed by the DoD can be viewed as focused according to specific outcomes:

Institutional training for the military and civilian workforce:

- Weapon system acquisition-related training is developed and implemented to specifically support the fielding of new systems or major modifications of systems.
- Operational and field training primarily as part of individual, unit and organisational training typically conducted at home station, during major training events and while operationally deployed.
- Self-development training where individuals seek additional knowledge growth that complements what has been learned in the classroom and on the job.

Manpower and Personnel

Description

It is essential to identify and acquire personnel (military and civilian) with the skills and grades required to operate, maintain, and support systems over their lifetime. Early identification is essential. If the needed manpower is an additive requirement to existing manpower levels of an organisation, a formalised process of identification and justification must be made to higher authority.

Overview

The terms "Manpower" and "Personnel" are not interchangeable terms.

"Manpower" represents the number of personnel or positions required to perform a specific task. This task can be as simple as performing a routine administrative function, or as complex as operating a large repair depot. Manpower analysts determine the number of people required, authorised, and available to operate, maintain, support, and provide training for the system. Manpower requirements are based on the range of operations during peacetime, low intensity conflict, and wartime. Requirements should consider continuous, sustained operations and required surge capability.

"Personnel," on the other hand, indicates those human aptitudes (i.e., cognitive, physical, and sensory capabilities), knowledge, skills, abilities, and experience levels that are needed to properly perform job tasks. Personnel factors are used to develop the military occupational specialties (or equivalent DoD Component personnel system classifications) and civilian job series of system operators, maintainers, trainers, and support personnel.

Personnel officials contribute to the Defense acquisition process by ensuring that the program manager pursues engineering designs that minimise personnel requirements and keep the human aptitudes necessary for operation and maintenance of the equipment at levels consistent with what will be available in the user population at the time the system is fielded.

Manpower & Personnel is one of the twelve Integrated Product Support Elements. The activities occurring within the scope of this area should be integrated with other product support element areas in keeping with KPP and KSA optimisation goals and constraints.

Importance

The mix of military, DoD civilian, and contract support necessary to operate, maintain, and support (to include providing training) the system will be determined based on the manpower mix criteria (see DoD Instruction 1100.22). Manpower mix data will be reported to cost analysts and factored into the preparation of independent cost estimates and DoD Component cost estimates. Economic analyses used to support workforce mix decisions will use costing tools, to include DoD Instruction 7041.04 (Reference (bn)), that account for fully loaded costs (i.e., all variable and fixed costs, compensation and non-compensation costs, current and deferred benefits, and cash and in-kind benefits) approved by the DoD Component manpower authority.

The role of Manpower Planning is to establish the right mix of personnel required for a program: military (Active, Guard, and Reserve), government civilians (U.S. and foreign nationals) and contract support manpower. Manpower analysts determine the number of people required, authorised, and available to operate, maintain, support and train for the system. Requirements are based on the range of operations during peacetime, low-intensity conflict, and wartime, and should consider continuous, sustained operations, and required surge capability. (Defense Acquisition Guidebook [DAG], Chapter 5-2.1.1) Manpower is typically the highest cost driver in the development and sustainment of acquisition programs and can account for 67-70% of the program budget.

When Manpower Planning is engaged along with Human Systems Integration, Program Managers have the tools to effectively manage systems and to ensure that the human element of the system is included in the pros, cons, and risks of using a program. (Defense Acquisition Guidebook [DAG], Chapter 5-2.1)

Manpower estimates serve as the authoritative source for out-year projections of active-duty and reserve end-strength, civilian full-time equivalents, and contractor support work-years. As such, references to manpower in other program documentation should be consistent with the manpower estimate once it is finalised. In particular, the manpower estimates should be consistent with the manpower levels assumed in the final Affordability Assessment and the Cost Analysis Requirements Description (CARD).

Facilities and Infrastructure

Description

Consists of the permanent and semi-permanent real property assets required to support a system, including studies to define types of facilities or facility improvements, location, space needs, environmental and security requirements, and equipment. It includes facilities for training, equipment storage, maintenance, supply storage, ammunition storage, and so forth.

Overview

Facilities and Infrastructure is a key element of the DoD acquisition process. This discipline encompasses a variety of functions that focus on the life cycle design, construction, resourcing and maintenance of military installations, facilities, civil works projects, test ranges, airfields, roadways, maintenance depots and ocean facilities. Due to the potential long lead times in funding (i.e., MILCON), acquisition or construction, and resourcing, planning must start early in the acquisition process with validation to ensure requirements are aligned to facilities planning objectives.

Facility sustainment efforts do not include:

- Activities related to Restoration or Modernisation
- Repair or replacement of non-attached equipment or furniture, or building components that typically last more than 50 years (such as foundations and structural elements)
- Tasks associated with facilities operations (such as custodial services, grass cutting, landscaping, waste disposal, and the provision of central utilities)
- Environmental compliance efforts, specialised historical preservation, or costs related to “acts of God,” all of which are funded elsewhere.

Some key terms related to Facilities and Infrastructure:

- Facility– A real property entity consisting of one or more of the following: a building, a structure, a utility system, pavement, and underlying land.
- Facility substitutes—Items such as tents and prepackaged structures requisitioned through the supply system that may be used to substitute for constructed facilities.
- Force beddown—The provision of expedient facilities for troop support to provide a platform for the projection of force.
- Forward arming and refuelling point—A temporary facility, organised, equipped, and deployed to provide fuel and ammunition necessary for the employment of aviation manoeuvre units in combat.

- Maintenance—The routine recurring work required to keep a facility in such condition that it may be continuously used at its original or designed capacity and efficiency for its intended purpose.
- Real property—Lands, buildings, structures, utilities systems, improvements, and appurtenances, thereto that includes equipment attached to and made part of buildings and structures, but not movable equipment.

Importance

Programs' responsibilities for facilities and infrastructure vary depending on the scope and outcomes of the program. Generally, for programs delivering weapon systems, coordination with the appropriate installation, test range, or other facilities proponent organisations is required early in the acquisition process. The funding, management, sustainment, upgrade and even disposal of facilities may be the responsibilities of multiple organisations. Program leadership must examine each facilities requirement to determine the appropriate management approach.

Facilities and Infrastructure is one of the twelve Integrated Product Support Elements. The activities occurring within the scope of this area should be integrated with other product support element areas in keeping with KPP and KSA optimisation goals and constraints.

IT Systems Continuous Support

Description

Information technology systems continuous support encompasses the facilities, hardware, software, firmware, documentation, manpower, and personnel needed to operate and support mission critical information technology systems hardware/software systems.

As the primary end item, support equipment, and training devices increase in complexity, more and more software is being used. The expense associated with the design and maintenance of software programs is so high that one cannot afford not to manage this process effectively and proactively. It needs to become standard practice for the Program Manager (PM) and Product Support Manager (PSM) to participate in the engineering and continuous development process from program inception to ensure software engineers, systems engineers, users, and product support managers are integrated and collaborating continuously in order to accomplish the necessary planning and management of IT systems continuous support to include management of weapon system information assurance across the system life cycle.

Information systems, electronics, and software are often part of the technical data that defines the current and future configuration baseline of the system necessary to develop safe and effective procedures for continued operation of the system.

Software technical data comes in many forms to include, but not limited to, specifications, flow/logic diagrams, Computer Software Configuration Item (CSCI) definitions, test descriptions, operating environments, user/maintainer manuals, and computer code. IT systems interface with the Global Information Grid (GIG) via the Defense Information Switch Network (DISN) or other network connectivity must be identified, managed, and actively coordinated throughout the life cycle to assure mission critical connectivity.

Electromagnetic Compatibility/Interference (EMC/EMI) requirements must be periodically evaluated and tested as weapon systems and mission scenarios evolve. Electromagnetic Pulse and other survivability requirements must be evaluated and tested at specific intervals over the life cycle.

System Security/Information Assurance is a total life-cycle management issue, with a constantly evolving cyber threat. Consider cybersecurity and supply chain risk management practices throughout the lifecycle to reduce vulnerabilities. Disaster recovery planning and execution is a requirement for mission critical systems and will be driven by continuity of operations plans of the using organisations.

Automated Identification Technology (AIT) will be a significant consideration for systems that deploy or components that are transported through standard supply channels for distribution, maintenance, and repair. Electronic Data Interchange (EDI) will be a constant management challenge as commercial methods and standards will change many times during the operational life of a weapon system.

PMs, through the PSM, need to coordinate at program inception with an organic software engineering entity in order to identify intellectual property and data rights for inclusion in subsequent contracts. PSMs should collaborate with the software engineers in order to tailor data/license rights acquisition and ensure it is aligned with the acquisition and product support strategies. The PSM will also ensure the data rights and license management strategies are documented within the IP strategy. The PSM will coordinate with the software engineer to develop a holistic business case analysis to determine a best value product support strategy that considers all aspects of hardware and software.

Overview

Nearly all DoD systems rely on information technology and software for their operation, integrated into every facet of military systems, from the more common Information Technology (IT) systems to the less obvious "embedded" software-intensive systems. Software is embedded in the weapon system, ground equipment, test equipment, and support equipment that the DoD delivers to the fleet and supports throughout their life cycle. It adds tools and weapons capabilities that would likely not be possible otherwise. With the advent of software-driven Portable Electronic Maintenance Aides (PEMA), diagnostics and prognostics, and maintenance data collection systems, software is also an increasingly critical part of the maintenance environment.

Information technology means that any equipment, or interconnected system(s) or subsystem(s) of equipment, that is used in the automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the agency. The term “information technology” includes computers, ancillary equipment (including imaging peripherals, input, output, and storage devices necessary for security and surveillance), peripheral equipment designed to be controlled by the central processing unit of a computer, software, firmware and similar procedures, services (including support services), and related resources. The term “information technology” does not include any equipment acquired by a contractor incidental to a contract.

Per the Technical Data and Computer Software Rights Handbook 9th Edition , computer software is defined as computer programs, source code, source code listings, object code listings, design details, algorithms, processes, flow charts, formulae and related material that would enable the software to be reproduced, recreated or recompiled, but excludes computer databases or computer software documentation. This definition does not expressly mention firmware as being a type of computer software. Nevertheless, the software portion of firmware is encompassed by the broad definition of the term “computer program,” i.e., “a set of instructions, rules, or routines recorded in a form that is capable of causing a computer to perform a specific operation or series of operations.”

Computer hardware, due to the rapid pace of technology change, is often acquired through a Commercial-Off-the Shelf (COTS) system. Per the Defense Acquisition Guidebook, maximum use of mature technology (including non-developmental and/or standards-based COTS computer hardware) provides the greatest opportunity to adhere to program cost, schedule, and performance requirements by leveraging industry's research & development and is consistent with an incremental acquisition approach. However, this is not a one-time activity.

Unanticipated changes and the natural evolution of commercial items may drive reconsideration of engineering decisions throughout the life cycle. In addition, the program must consider the logistics implications of supporting commercial items in a military environment. Finally, because COTS items have a relatively short life, a proactive diminishing manufacturing sources and material shortages/obsolescence approach should also be considered. Consequently, care must be taken to assess the long-term sustainability of COTS options and to avoid or minimise single source options.

Because software is fundamentally different from hardware, these differences factor into the approach for sustaining software systems.

What Makes Software Different than Hardware

Cause of Failures	In hardware, most failures can be traced back to problems to material and manufacturing issues. Software defects usually are built into the system as a result of undiscovered errors in the requirements, design, and coding.
Product Life (Wear-out)	Hardware will physically wear out over time. Software, not being a physical product, does not wear out.
Reparability	When hardware breaks, parts are replaced to maintain the system in operation. When software breaks, the software must be analysed, redesigned, and recoded to bring the system to full functionality.
Reliability	Hardware reliability is predictable. Software reliability is not predictable and depends almost entirely on human factors in design.
Redundancy	Hardware reliability will improve when redundant components are used in the system. Software reliability will not improve with redundant software modules. An error that affects one software module will affect all similar modules.
Interfaces	Hardware interfaces have physical properties and can be visually inspected. Software interfaces are purely conceptual and cannot be completely tested.
Component Standardisation	Hardware modularisation helps improve maintainability and reduce downtime. Software code modularity has been around for some time but is used to a limited extent. Strictly speaking there are no standard parts for software.

Importance

The role of information technology and computer hardware and software is becoming ever more integral to the operation and support of all weapon systems. In fact, most weapon systems can no longer function properly without their integrated information technology system operating correctly.

According to Government Accountability Office reports, DoD's weapon systems are more software dependent and more networked than ever before—making them more vulnerable to cyberattacks. DoD's networks can also be used to attack other information technology systems. The DoD is now prioritising cybersecurity in weapon systems acquisition.

INTERFACE WITH PROJECT CONTROLS

In addition, IPS interfaces with, but not limited to:

- Cost Management
- Schedule Management
- Risk Management
- Quality Management
- Performance Management
- Configuration Management
- Resource Management
- Human Resources
- Information Management
- Contract Management.

SUMMARY

The future of IPS is poised to evolve significantly, driven by technological advancements, changing industry standards, and evolving customer expectations.

The increase in awareness and use of the S Series Specifications, specifically S1000D, S2000M and S3000L, in the shorter term will further support a solution that can complement IPS or be used as individual tools to achieve the

IPS is geared towards greater efficiency, reliability, and customer satisfaction through the integration of advanced technologies and innovative practices. Companies that embrace these changes will be better positioned to deliver superior support services, reduce operational costs, and enhance the overall value proposition for their customers.

RECOMMENDATIONS

The following content addresses potential recommendations and the associated solutions from both an Australian Defence and Australian Defence Industry perspective. As this is an evolving landscape and the initial drive will be from Defence, clarity around decisions and outcomes are somewhat more advanced than those of industry on the whole. Some prime contractors ('primes') within Australia who have international parent companies will have already had some exposure to IPS and be adopting the relevant elements as necessary. The remaining industries will take more time and need more experience in projects to fully embrace potential IPS solutions.

With that in mind the information below from a Defence perspective will be more mature and comprehensive while the industry side, the majority of, excluding 'primes', will be still in the early stages. What the author is trying to convey is that from an industry outlook it will be a lot of speculation, so the absence of a topic on the industry side does not correlate to nothing been done, it is simply in a formative state.

STRATEGIES

Defence

Defence strategy provides a fundamental influence on Defence Logistics. Multinational responses to global security situations have become the new normal and at any given time the ADF may be engaged in concurrent war fighting, stability and humanitarian operations. This contemporary operational environment requires agile, robust, networked, interoperable and deployable logistic systems.

The global integration and coordination of business, economies and communications is a key influence on Australia's national and Defence Logistic capability. Nations are becoming increasingly interdependent, leading to global supply chains and markets. The globalisation of logistics has the potential to extend the reach and flexibility of Defence Logistic capabilities and heightens the requirement for effective management of global supply chains by Defence Logisticians.

The globalisation of logistics is driving the evolution of interoperable logistics systems, which in turn provides opportunities for addressing the emerging global challenges. It also identifies that a key input to success is the establishment of a coherent and coordinated Australian Defence Logistics enterprise to drive our engagement with the global logistic environment. Key influences in this regard will include:

- **United States Defence Logistics**. As a major ally and major global supplier of defence materiel, the United States (US) exerts significant influence over Defence Logistics and provides a range of potential benefits. The US is building a global support network to enable the deployment and sustainment of operations that can potentially provide Australia with secure access to data, information, contracting arrangements and infrastructure.
- **Interoperability**. There is a growing trend amongst Australia's key allies to achieve higher levels of interoperability in response to the ongoing need for multinational responses to international crises. There is growing focus on standardisation of materiel, distribution modes, data sharing and systems, commonality of doctrine, procedures and equipment. Logistic interoperability simplifies planning and enhances the effectiveness of bilateral or multinational relationships.
- **Global Supply Chains**. Dependency on global supply chains is increasing as globalisation expands. It provides the ability to develop, procure, sustain and operate Defence capabilities that would otherwise be beyond the reach of a single nation.
- **Data**. There is a growing abundance of data and therefore a need for interconnectedness of information management systems and common data models to support analysis of that data.
- **Efficiency**. Government expects Defence outcomes to be delivered in the most cost-effective manner and that opportunities for efficiencies are capitalised upon whenever practicable.

POLICY, PROCEDURES AND PLANNING ARTEFACTS

Defence

Defence policy directs us to maximise the use of civil and commercial standards where operationally and technically acceptable, practical and cost-effective.

New contemporary Defence and CASG and IPSMS policy, procedures and planning artefacts will be developed. New IPSMS policy, procedures and planning artefacts will be framed and informed by the IPS Specification and Elements. All new policy, procedures and planning artefacts will be integrated into the broader superordinate Capability Life Cycle (CLC) policy and guidance. A key feature of the new policy, procedures and planning artefacts will be a robust responsibility and accountability matrix.

Acknowledging IPS is conducted across the broader DefLogEnt, strategic IPSMS policy defining the service requirements will reside at the Defence level. IPSMS procedures defining the how those requirements are delivered will reside at the CASG level. Planning artefacts will reside at the Defence level. All APS, ADF and Industry workforces undertaking IPS activities will be expected to comply with the defined policy, procedures and planning artefacts. Service and Domain procedures are necessary when defining logistical service delivery in specific operational environments; however, they must not duplicate, replicate or negate Defence and CASG policy and procedures.

ASSESSMENT

Defence and Industry

IPS Assessment (IPSA) will be the analysis of the IPS Programs competence and capacity to acquire and sustain an optimal Support System. IPSA will be conducted across the acquisition and sustainment phases of the CLC. The DML will be accountable for ensuring an IPSA Program is established, resourced and conducted. An IPS Assessment tool will be developed to facilitate the IPSA. The DIPSS will be responsible for ensuring IPSA is conducted.

The IPSA is not a compliance audit; rather it is an assessment of the IPS Programs planning, how the plans will lead to a sustainable and affordable Support System solutions. IPSA will be conducted by an independent and impartial team of skilled and experienced ML Function Logisticians not directly associated with the IPS Program being assessed. Key element of IPSA will include an assessment of the:

- IPS Manager and IPS Team qualifications and experience,
- resources made available to the IPS Manager to conduct an effective IPS Program, and
- required IPS planning artefacts are being managed and have been endorsed.

IPSA will be conducted well in advance of the mandated CLC review events, the intent being to support the IPS Manager through the events, not hinder them. The focus is on whether the IPS Program planning and methodology can be successfully executed. Conducting IPSA early in the CLC where the design can be influenced, and re-assessing the planning at each milestone and periodically thereafter as the design matures, is critical to transitioning a sustainable Support System. It also provides senior decision makers critical information for making strategic trades within and across various programs, especially as today's Mission and Support Systems are becoming increasingly complex and integrated with other Mission and Support Systems.

PROFESSIONAL DEVELOPMENT

Defence

Chief of Joint Capability (CJC) is accountable for managing the professional development of the Logistic Job Family. CJC has delegated accountability for the professional development of the ML Function occupations of the Logistic Job Family to the ML Function Lead15.

The ML Function Lead has further delegated the professional development accountability for the IPS occupations to the Product Support Management Functional Authority (PSMFA).To verify the IPS occupations receive the required level of learning and deliver on the ML Function Leads accountabilities to CJC, the PSMFA will develop and maintain an IPS Learning Specification. The Learning Specification will be endorsed by CJC, ML Function Lead and CJLOG.

The Learning Specification guiding principles will be:

- Build a capable IPS workforce with breadth and depth of expertise.
- Commit to building future IPS Managers through identification, mentoring, coaching and certification.
- Commit to and foster a culture of continuous lifetime learning.
- Make investing in professional development a priority.
- The development and continual improvement of IPS learning products and services, and the ML Function IPS Skill Sets, Qualifications and units of competence.

The Learning Specification will be enabled by the Assistant Director Materiel Logistics Professionalisation, with a focus on ensuring:

- Learning products and services, defined by the Learning Specification are available and fit for purpose.
- The IPS workforce is actively engaged in using the learning products and service.
- Validation that the required skills levels are being achieved through formal competency assessments against the authorised ML Function IPS Skill Sets and Qualifications.

Industry

With a diverse range of knowledge and experience in industry there are international companies that provide training for IPS at various levels. Defence is also actively involved in making content and learning available to industry through its own training framework.

Similar to ILS, there will be companies that decide to undertake training in aspects of IPS that they are working in so as to compliment the work they are undertaking.

A good resource as a starting point might be Defence Acquisition University (DAU).

IPS LEARNING CERTIFICATION FRAMEWORK

Defence

Certification will be a key element of the Learning Specification and should be viewed as 'quality' ranking rather than a 'mandatory' qualification. However, it is expected all IPS Managers selected/posted to ACAT I/II and SCAT I/II programs will have or be able to achieve certification within an agreed timeframe following placement in the role. The APS selection panel chairperson/delegate or Service posting authorities will need to justify why an un-certified applicant is selected/posted over a certified applicant.

Certification will be achieved by:

- Undertaking the required leadership and mandatory training courses and defined IPS core and role-specific training courses that are nationally accredited and recognised by (and open to) Industry.

- Building and maintaining skills and experience by performing in an IPS Manager position (on the job learning).
- Being assessed as competent against the ML Function IPS Skill Sets and ML Qualifications.

Verification that the required skill level has been achieved will be conducted through competency assessments against the ML Function IPS Skill Sets. IPS Managers who believe they have the required skill levels may tailor-out some certification requirements (i.e. non-core training courses); however the requirement to have skill levels verified against the ML Function IPS Skill Set cannot be waivered.

Industry

From an industry perspective whilst there are international companies that provide training, Australia doesn't have any formal IPS training. Initially there will be a reliance on Defence to provide training in a capacity that will be slow to roll out initially, as Defence is also just starting on its IPS journey as well.

Even with these constraints, utilising courses, or training form international companies will still provide a knowledge and understanding of IPS and will bring a more diversified set of skills to the Australian pool ok knowledge.

The DAU provides its own US based certification framework. However, that body of knowledge contains a lot of content and coursework around IPS that may provide and initial starting point to understand how to develop future certifications under an Australian framework like the Australian Qualifications Framework.

IPS GOVERNANCE FRAMEWORK

Defence

The Defence Capability Portfolio is a collection of Programs that aggregate component Product at varying stages of their individual life cycles. A Project is a discrete activity to introduce, upgrade or replace a Product. Product Management outcomes are agreed between the Capability Managers (CM) and CASG through Product Delivery Agreements.

IPS Management in the context of Product Management should be thought of as the Support Elements Products and Services, that when integrated delivers optimal Support System solution. Support Elements Products and Services must be grouped into the Support System Constituent Capabilities in a way that allows the CM to manage those Support Elements Products and Services in a coordinated and integrated manner, optimising the capability outcome within allocated resources.

The IPS Manager will understand how each IPS Element is affected by and linked with the others and as such, will adjust them in an integrated fashion to reach the goal of balancing customer/stakeholder requirements for suitability and affordability. Regardless of how Support Element Products and Services are packaged, the IPS Manager will be wary of delivering stove-piped support solutions, missing integration opportunities.

Industry

From and industry perspective there will be a reliance upon Defence initially to provide guidance on a governance framework. That said whilst the ILS governance framework may need to be replaced, it might be usual as a starting point to build the necessary requirements for the IPS.

IMPLEMENTATION

Defence

To ensure effective IPS outcomes, CASG MLF are developing and implementing the IPS Management System (IPSMS). The IPSMS will deliver the Governance and Assurance Framework that provides clarity to the workforce through governing principles within the Defence IPS Policy. The subordinate document information architecture will deliver clear and concise processes and procedures that enables effective assurance activities. In implementing the IPSMS, there will be a focus on ensuring workforce competency through professionalisation. This will set us up for success to embrace risk and make informed evidence based decisions.

Australia's strategic risks are changing and so must our thinking about how we ensure preparedness for the future customer/stakeholder. In the Australian Defence context, IPS will be conducted mainly within the Capability Support dimension, although the consequences of ineffective IPS will manifest themselves in ineffective support to operations and ultimately ineffective operations. The proposed IPSMS will leverage features from the UK MoD and US DoD models and be framed by the IPS Specifications and Elements. Key elements of the proposed model will include:

- **Strong Leadership:**
  - A Director IPS Services Support (DIPSS). The DIPSS is the Defence IPS Champion and is accountable for the provision of strong support from the ML Function Centre.
  - Establishing an IPS Manager10as a key acquisition and sustainment leader in Projects and System Program Offices (SPO) providing strong support solution outcomes to Capability, Project and Product Managers.
- **Strong Governance:**
  - Contemporary CASG and Defence IPS policy and procedures; framed by the IPS Specification and Elements.
  - Contemporary IPS planning artefacts. This will include defined artefact development and endorsement accountabilities.
  - Defined IPS Manager accountabilities and responsibilities, reinforced through strategic Defence policy directives.
  - An IPS Assessment Program and Assessment Tool 11.
- **Capable Workforce:**
  - A Defined and managed IPS Learning Strategy aligned to Defence policy and nationally recognised qualifications and skill sets.
  - Targeted professional and development products and services.
  - An IPS Certification framework.
- **Informed Decisions:**
  - Support System solution design and optimisation decisions derived from Supportability Analysis data and systems.
  - Clear direction in the form of endorsed IPS planning artefacts.
- **Customer Focus:**
  - A contemporary IPS management engagement model.

STAKEHOLDER BENEFITS

Defence

The delivery of Materiel Logistics within Defence occurs within the bounds of a broad group of key stakeholders, ranging from the Minister for Defence down to service delivery agents.Each of these stakeholders owns a particular set of interests relating to the delivery of the materiel logistics business function, and the specific measures for success are unique for each position.

The implementation of an IPSMS, if properly resourced and supported, offers a range of significant benefits for stakeholders across the DefLogEnt, particularly regarding the manner in which risks are identified and managed. Some of these stakeholder specific risks are considered below, including the advantages that an IPS Management System offers in terms of reducing these key risks.

For further information on stakeholder benefits for Australian Defence refer to Integrated Product Support Management System – The contemporary evolution of Integrated Logistics Support, Evans and Ridder 03 Jun 2021.

Industry

IPS provides numerous benefits to stakeholders in the civilian industry by streamlining processes, enhancing product lifecycle management, and ensuring better customer satisfaction. Some of the key benefits are outlined as follows:

Enhanced Product Lifecycle Management

a. Effective Maintenance and Support: IPS ensures that maintenance strategies are well-planned and executed, reducing downtime and increasing product availability.
b. Lifecycle Cost Reduction: By integrating support throughout the product lifecycle, overall costs are minimised through proactive maintenance, better resource management, and improved spare parts forecasting.

Improved Customer Satisfaction

a. Reliability and Performance: With a focus on reliability and maintainability, products are more likely to perform as expected, leading to higher customer satisfaction.
b. After-Sales Support: Comprehensive support plans ensure that customers receive the necessary assistance and parts quickly, enhancing their overall experience with the product. This must be tempered with the ability to successfully utilise existing warehouse supplies or create a cost effective network that can achieve this benefit.

Optimised Supply Chain Management

a. Resourceful Inventory Management: Integrated Logistics Support helps in maintaining optimal inventory levels, reducing excess stock and the risk of shortages.
b. Supplier Coordination: Better coordination with suppliers ensures timely delivery of components and materials, contributing to a smoother production process. Which can be read in conjunction with after sales support to meet the network requirements.

Cost Savings

a. Economies of Scale: Integrated support can lead to bulk purchasing and more efficient use of resources, resulting in cost savings. A challenge in Australia is that there is a much smaller economy of scale being utilised and is somewhat reliant on international company support to either kickstart a capability and then having the investment to sustain or grow the capability.

b. Reduced Operational Costs: Streamlined processes and better planning reduce waste and unnecessary expenditures. Whilst this is a potential benefit, there will be a large amount of investment in time and money before that return on investment will produce consistent operational cost savings.

Increased Operational Efficiency

a. Streamlined Processes: IPS integrates various support elements such as maintenance, logistics, and training, leading to more streamlined and efficient operations.
b. Improved Resource Utilisation: Effective planning and management ensure that resources are used optimally, enhancing overall operational efficiency.

Better Risk Management

a. Proactive Problem Solving: By anticipating and addressing potential issues early in the product lifecycle, IPS helps in mitigating risks that could impact product performance and customer satisfaction.
b. Compliance and Standards: Ensuring that all support activities comply with industry standards and regulations reduces the risk of non-compliance and associated penalties.

Enhanced Collaboration and Communication

a. Integrated Information Systems: Shared information systems and databases facilitate better communication and collaboration among different departments and stakeholders.
b. Alignment of Objectives: Ensuring that all stakeholders are aligned with the same objectives and strategies leads to more cohesive and effective product support.

Innovation and Continuous Improvement

a. Feedback Loop: Continuous feedback from maintenance and support activities provides valuable insights for product improvement and innovation.
b. Adoption of Best Practices: IPS promotes the adoption of industry best practices, leading to continuous improvement in support processes and product performance.

Sustainability and Environmental Impact

a. Sustainable Practices: Integrating environmentally friendly practices throughout the product lifecycle reduces the environmental footprint.
b. Resource Efficiency: Efficient use of materials and energy contributes to more sustainable operations.

RESOURCE REQUIREMENTS

Defence

Director Integrated Product Services

The transition and sustainment of the IPSMS will requires the establishment of new Director Integrated Product Support Services (DIPSS).

- **Transition**. The DIPSS will be the Defence IPS Champion and accountable for the establishment and transition of the IPSMS.
- **Sustainment**. DIPSS will be accountable for the provision strong support from the ML Function Centre in the form of the products and service provided by the ML Function Disciplines to all ML Function Logisticians.

The Director Materiel Logistics (DML) will remain accountable for the management of the ML Function Centre and manage the Functional Authorities. In accordance with the Materiel Logistic Management System, the six Functional Authorities will remain responsible for the provision of their respective discipline's products and service, as follows:

- Product Support Management
- Logistic Support Analysis
- Technical Logistics
- Codification
- Support Chain Management
- Materiel Management.

Integrated Product Support Manager

The key to success is strong leadership provided by highly skilled and experienced managers. Defence cannot outsource risk; commercially sound decisions made by our Defence Industry partners do not always translate to optimal Support System solutions for the customer/stakeholder. CASG proposes the establishment of a new occupation within the Materiel Management Job Function, the IPS Manager.

The new position will ensure the Support System is fully integrated and meets the customer/stakeholders needs in terms of readiness, reliability and affordability. It is proposed this occupation can only be held by Defence personnel. Industry will not be eligible to undertake the role of an IPS Manger in Defence. A new IPS Manager occupational profile will be created and a standard job title applied.

This new role is facilitated by the Product Support Management (PSM) IPS Element and provides the framework for the integration of the other 11 IPS Elements. The IPS Manager will not conduct activities associated with the other 11 IPS Elements. They are responsible for within the leading, planning and governing boundaries for designing, acquiring, transitioning and optimising the effective and affordable authorised Support System solution framed by the Support System Constituent Capabilities. This is achieved by firstly understanding the CM operational requirements and translating them into a Support System solution that will deliver optimum operational preparedness for the customer/stakeholder. The IPS Manager will also be accountable for forming and managing the IPS Team.

The IPS Manager will be a key leadership position in Defence Capability acquisition and sustainment programs. It is proposed an IPS Manager must be assigned to every:

- Acquisition Category (ACAT) I and II projects, at project initiation.
- Sustainment Category (SCAT) I and II SPO, prior to the transition of the Support System to the SPO.
- Sustainment Category (SCAT) I and II SPO's that are predominately a 'performance based model' outsourced to Industry.
- Non-ACAT/SCAT I and II projects and SPOs will be encouraged to establish IPS Manager positions as career development pathway.

ILS Managers will progressively be transitioned to the new IPS Manager occupation after completing the required learning and certification requirements. Certification will be available to all IPS Managers (APS and ADF). Other ML Function Logisticians (APS and ADF) who choose IPS Management as a career pathway and whose goal is to be selected/posted to a ACAT I/II and SCAT I/II position are also welcome to undertake certification.

A significate contributing factor to providing effective IPS management is the support provided to IPS Managers from the ML Function Centre. The IPS Manager will have a dual reporting relationship and is accountable to the both the Project and Product Manager, and the ML Function DIPSS for the provision of IPS. Both reporting relationships are equally important.

Integrated Product Support Team

As an exemplar, the IPS Team will consist of ML Function Logisticians from the six Functional Disciplines and will be a blend of Defence and Defence Industry ML Function Logisticians. The IPS Team would be responsible for establishing goals, developing plans and actions and identifying the required resource to deliver on the plans.

The development of an effective Mission and Support Systems requires the participation and consensus of all Project and Product Management Teams. The IPS Team will be a specialist functional element of the broader Project and Product Management Teams. It is important the IPS Team are able to work across functional and organisational boundaries. The IPS Team will need to establish strong relationships with the broader teams, in particular the Systems Engineering functional team.

The structure of the IPS Team would vary depending on which phase of the CLC IPS is being conducted and the complexity of Mission and Support System. The IPS Manager must consider where the Mission and Support Systems are in the CLC and understand the major design points or events to ensure the right IPS skills are available to provide informed decision, enabling the Mission and Support Systems to move forward through the CLC.

Industry

For transparency the IPS duties listed below are taken from the DoD developed 'Product Support Manager Guidebook'. Whilst this is a U.S. context and a lot of the acronyms refer to U.S. terminology, the intention as far as the author is aware, as is the case with a lot of Australian Defence decisions, is to follow the lead of those that have already done and/or doing. So the duties may over time become more tailored as Defence and industry grow through experiential learning.

Integrated Product Support Manager

The principal duties of the PSM are as follows:

1. Provide weapon system product support Subject Matter Expertise (SME) to the Program Manager (PM) for the execution of the PM's duties as the Total Life Cycle Systems Manager.
2. Develop and implement a comprehensive, outcome-based product support strategy (PSS). The PSS, which includes a description of the implementation of the 12 Integrated Product Support Elements, should be designed to maximise value to the DoD by providing the best possible product support outcomes for the Customer/stakeholder at the lowest Operation and Support (O&S) cost. Documented in the LCSP, the strategy is generally expressed in terms of the Sustainment KPP (consisting of Materiel Availability (Am) and Operational Availability (Ao)); KSAs or Additional Performance Attributes (APAs) of reliability, maintainability, and O&S cost; and additional metrics as appropriate.
3. Promote opportunities to maximise competition and small business participation at the appropriate tiers while meeting the objective of best value, long-term outcomes to the Customer/stakeholder. Securing the appropriate intellectual property (IP) and rights to enable opportunities to maximise competition, where there is more than one available source, is a means to an end (i.e., obtaining supplies and services at the best value to the Government). Trade offs between the benefits of long-term relationships and the opportunity for cost reductions through the competitive processes should be considered together with associated risk.

4. Leverage enterprise opportunities across programs and DoD Components. Enterprise strategies are a priority where the component, subsystem, or system being supported is used by more than one Component. Product support strategies should address a program's product support interrelationship with other programs in their respective portfolio and joint infrastructure, similar to what is performed for operational interdependencies.
5. Coordinate with the Lead System Engineer and reliability and maintainability engineering to use the results of appropriate predictive analytical tools to determine the preferred PSS that can improve material availability, reliability, maintainability, and reduce O&S cost. Analytical tools can take many forms, such as Analysis of Alternatives (AoA), Supportability Analysis, Reliability Growth Analysis, Core Logistics Analysis/Depot Source of Repair, and Product Support BCA (including cost benefit analysis, as outlined in Office of Management and Budget Circular A-94, and the DoD Product Support BCA Guidebook). The choice of tools depends upon what is being evaluated and the stage within the program's Life Cycle. Where applicable, tools should analyse the digital representation (e.g., three-dimensional models and other digital product information) of the system being developed using the digital Authoritative Source of Truth.
6. Predictive analytical tools are used to help identify the best possible use of available DoD and industry resources at the system, subsystem, and component levels by analysing all alternatives available to achieve the desired performance outcomes. Additionally, resources required to implement the preferred alternative should be assessed with associated risks. Sensitivity analyses should also be conducted against each of the IPS Elements and tracked to determine those IPS Elements where marginal changes could alter the preferred strategy.
7. Develop appropriate PSAs for implementation. These arrangements could take the form of memorandums of agreements, memorandums of understanding, performance-based agreements, service level agreements, and commercial services agreements, along with partnering agreements or contractual agreements with PSIs and PSPs, as appropriate. Development and implementation of PSAs should be a major consideration during strategy development to assure achievement of the desired performance outcomes.
8. Working in concert with the PM, users, resource sponsors, and force providers, adjust performance levels and resources across PSIs and PSPs as necessary to optimise implementation of the strategy and manage risk based on current Customer/stakeholder requirements and resource availability.
9. Ensure that PSAs for the weapon system describe how such arrangements ensure efficient procurement, management, and allocation of Government-owned parts inventories in order to prevent unnecessary procurements of such parts.
10. Document the PSS in the LCSP. The LCSP describes the plan for the integration of sustainment activities into the Acquisition Strategy and operational execution of the product support strategy. The PSM prepares the LCSP to document the plan for formulating and executing the PSS so the design and every facet of the product support package (including any support contracts) are integrated and contributes to meeting the Customer/stakeholder's mission requirements. The LCSP is updated to reflect the evolving maturity of the PSS and associated arrangements at a minimum prior to each change in the PSS or every five years, whichever occurs first.

11. Conduct periodic PSS reviews or sustainment reviews for covered systems. The PSS evolves with the maturation of the weapon system through its Life Cycle phases. At Full Rate Production (FRP), the LCSP should describe how the system is performing relative to the performance metrics and any required corrective actions to ensure the metrics are achieved. Reviews and revalidations of the strategy and underpinning analysis should be performed at a minimum of every five years or prior to each change in the strategy to ensure alignment across system, subsystem, and component levels in support of the defined best value outcomes. The PSM's reassessment should evaluate potential opportunities for evolving toward an enterprise portfolio approach (i.e., across platforms; inter-Service) where opportunities for leveraging commonality and economies of scale exist. In all situations, the reassessment should consider opportunities to make better use of industry and DoD resources. Maintenance Planning and Management. The PSM is responsible for providing the planning, documentation, and for advocating and resourcing depot activations to meet fielded weapon system availability requirements. The PSM should also ensure funding is secured to provide for field and depot level maintenance and to provide requisite training and initial spares to support operation of the weapon system.

Integrated Product Team

The structure of the Integrated Product Team (IPT) may vary depending on the maturity and the mission of the program. Where appropriate, the team may employ an agile project management approach.

The IPSM need to consider where the system is in the life cycle, understand what major decision points or events are approaching, and ensure the correct representatives on the team to provide useful information to the decision makers for the program to move forward through the life cycle successfully.

IPT membership typically includes a program office "core" team who has a daily responsibility to plan, develop, implement, and oversee the product support strategy; the core team can be supplemented, often on an ad hoc basis, by other stakeholders and SMEs as needs arise. After the IPT is organised, the members establish their goals, develop plans of action and milestones (documented in an approved IPT Charter), and obtain adequate resources.

POTENTIAL BARRIERS

Defence and Industry

The transition from ILS to IPS may on the surface appear relatively straightforward as there is minimal differences in a majority of the elements that are being applied. That said the two extra elements in IPS and the intention to engage with design earlier in a project will have larger ramifications that will scale up or down depending on the cost of the investment in the capability.

These challenges will be seen both in Defence and Industry and whilst Defence have deeper pockets, industry, which is currently dealing with the introduction of S1000D and other S Series Specifications, will be faced with yet another process, technology, system engineering based workflow and has to decide whether to invest in now or wait until IPS is better understood and better implemented.

Other important challenges faced by both Defence and industry alike might include:

Organisational Challenges:

- **Complex Organisational Structure**. Given the size of both groups and depending on the industry prime being spoken about there is a complex hierarchical structure, which can make the integration of new systems and processes demanding. Coordination across different branches, units and lines of business can be difficult.

- **Simple Organisational Structure**. In contrast to the complex structure above, small industry businesses may not have the revenue, resources or hierarchical structure to support the adoption of IPS and may have to either contract out, or target a couple of elements finding a niche, which some current ILS industries have done very successfully.
- **Bureaucratic Inertia**. Large organisations like the ADF or some 'primes 'often have established procedures, resistance to change and in some cases international governance that may not directly align. Overcoming bureaucratic inertia requires significant effort and strong leadership commitment.
- **Lack of Centralised Oversight**. Effective IPS implementation requires centralised oversight and management. If the responsibility for IPS is fragmented across different departments, it can lead to inconsistencies and inefficiencies. As a counter thought to this paradigm we live in a centralised world where power and focus are controlled by one group. That mentality radiates outwards in ever increasing circles not allowing random creative ideas to establish, they are drowned out by staid entropic materialistically driven individuals. The power of decentralisation where the nodes are ingenious teams that can tailor their environments to provide efficient proactive solutions that connect the required information potentially in ways that have not been thought of.

Technical Challenges:

- **Legacy Systems Integration**. The ADF uses various legacy systems that may not be compatible with modern IPS frameworks. Integrating these systems can be technically challenging and resource-intensive. In the industry space, whilst the uptake of new software and systems may occur at a greater frequency than Defence, there is still a requirement to align with Defence and therefore suffer the same legacy system issues. The cost of moving forward in technology and having to backstep data to align with older systems may also lead to increasing costs of workarounds to justify keeping up with the Internet of Things.
- **Data Management and Interoperability**. IPS relies heavily on accurate and timely data. Ensuring data interoperability and quality across different platforms and systems can be a significant technical hurdle. This is very much a catch 22 situation where it could be argued that in having a functioning IPS system that data can be interconnected more effectively and efficiently to create a greater data pool to be used.
- **Technological Infrastructure**. Implementing IPS requires robust technological infrastructure, including advanced software and communication systems. Ensuring that all components of the ADF have access to and can effectively use this infrastructure is essential. Industry has an edge on the ADF here as it is quicker and more cost effective to update infrastructure so as to keep a competitive edge. The ADF doesn't have that competition.

Financial Challenges:

- **Initial Investment Costs**. The initial costs associated with implementing IPS, such as purchasing new software, training personnel, and updating infrastructure, can be high especially in the ADF with the size of the organisation and the dispersion of staff. Securing the necessary budget can be a challenge. From the industry perspective, it may only require a large project that can be used to account for the infrastructure investment costs and then subsequent projects will offset equipment and personnel.

Cultural Barriers:

- **Resistance to Change**. Cultural resistance from personnel who are accustomed to existing processes and systems can be a significant barrier. Changing long-standing practices and mindsets requires effective change management strategies.

- **Training and Skill Gaps**. Implementing IPS requires personnel to have specific skills and knowledge. Ensuring that all relevant staff are adequately trained can be a significant challenge, particularly if there are skill gaps.
- **Communication and Collaboration**. IPS requires a high level of communication and collaboration between different departments and units. Ensuring effective collaboration can be difficult, especially in a large and diverse organisation like the ADF. As indicated above, there is the potential to create nodes that are decentralised that can work far more effectively internally and connect externally in something approximating a mesh network.

Strategic and Policy Barriers:

- **Alignment with Strategic Goals**. Ensuring that IPS initiatives align with the broader strategic goals and objectives of the ADF is crucial. Misalignment can lead to ineffective implementation and lack of support from senior leadership. In industry the absence of 'orders' and giving staff focused and clear goals, that will help them better understand and align with desired outcomes.
- **Policy and Regulatory Compliance**. IPS implementation must comply with existing policies, regulations, and standards. Navigating these requirements can be complex and time-consuming.
- **Supplier and Contractor Management**. IPS often involves collaboration with external suppliers and contractors. Managing these relationships and ensuring they adhere to IPS standards can be challenging. This will be difficult in industry, as the same challenges are being experienced in ILS. So only time will tell if suppliers will be able to tailor their outputs to meet IPS or whether the task of alignment will be conducted by the 'primes' of other small to medium companies.

CONCLUSION

IPS and ILS are both methodologies used to manage the support of systems and products throughout their lifecycle. Just as ILS has faced challenges over the past decades, IPS may encounter the same resistance both initially and ongoing.

IPS encompasses a wider range of support elements, including not only logistics but also product design, and a greater level of management and team involvement. This comprehensive approach makes sure that all phases of a product's lifecycle are considered, leading to more sustainable and efficient outcome.

IPS unlike ILS emphasises early integration of support considerations into the design phase, potentially leading to products that are easier and more cost-effective to support and maintain. There is also the potential with Model Based systems engineering methodology making a resurgence to compliment aspects of IPS and the S-Series Specifications and further consolidating the early design phase access.

IPS is designed to better accommodate advanced technologies and complex systems, which are increasingly prevalent in modern Defence equipment. Support for complex Defence systems becomes more crucial, complex and integrated and the comprehensive nature of IPS makes sure that all aspects of system support are considered, from software to hardware to human factors to more functional and interconnected technical documentation used to instruct, teach and learn.

Cross-functional integration of an IPS solution encourages collaboration across various disciplines and stakeholders, including design engineers, support engineers, logisticians, trainers and end users. This leads to better alignment of goals and more cohesive support strategies. The flow on effect is that the frameworks developed facilitate better engagement with suppliers and partners, ensuring that support considerations are integrated across the supply chain.

Alignment with global standards including international standards such as ISO 55000 (Asset Management) and the Defence Standard 00-600 (UK) and MIL-STD-3034 (US) and SAE JA1012 (AUS) can facilitate interoperability and compliance in multinational operations and collaborations. This makes sure that all product support activities are compliant with national and international regulations and provide better connectivity under the structured IPS framework.

By Integrating modern data analytics, IPS encourages the use of condition-based monitoring and potential real-time data to inform support decisions, leading to more effective and efficient support solutions. This will be complimented with ongoing data collection and analysis to enable continuous improvement in support processes and systems.

By integrating all these aspects and allowing for effective tailoring options, IPS can provide a more comprehensive, efficient, and effective support strategy for Australia's Defence capabilities, ensuring better lifecycle management, cost savings and operational readiness.

GLOSSARY OF TERMS

ASSIST	Originally known as Acquisition Streamlining and Standardization Information System. is the primary user interface of the Defense Standardization Program (DSP). It is also the official source of military specifications and standards identified on DoD contracts. The ASSIST suite of tools offers many more functions today than when it first began, providing online access to Defense standards and specifications. At the core of ASSIST is the repository of more than 27,000 active standardization documents adopted by DoD, and a system of analytical and workflow tools used by DoD to develop, maintain, search, and implement standardization documents.

LIST OF ABBREVIATIONS

AIT	Automated Identification Technology
ADF	Australian Defence Force
AIA	Aerospace Industries Association
AoA	Analysis of Alternatives
APS	Australian Public Service
ASD	Aerospace, Security and Defence Industries Association of Europe
ASoT	Authoritative Source of Truth
ATA	Air Transport Association of America
BCA	Business Cases Analysis
CARD	Cost Analysis Requirements Description
CASG	Capability and Sustainment Group
CJC	Chief of Joint Capability
CLC	Capability Life Cycle
CM	Capability Managers
COTS	Commercial Off The Shelf
CSCI	Computer Software Configuration Item
CSE	Common Support Equipment
DAU	Defence Acquisition University
DET	Displaced Equipment Training
DID	Data Item Descriptions
DIPSS	Director IPS Services Support
DISN	Defense Information Switch Network
DLF	Defence Logistic Framework
DML	Director Materiel Logistics
DoD	Department of Defense
EDI	Electronic Data Interchange
FRP	Full Rate Production
GAO	Government Accountability Office
GIG	Global Information Grid
IETM	Interactive Electronic Technical Manuals
ILS	Integrated Logistic Support
IMM	Integrated Materiel Managers
IPS	Integrated Product Support
IPSA	Integrated Product Support Assessment
IPSM	Integrated Product Support Management
IPSMS	Integrated Product Support Management System
IPT	Integrated Product Team
IT	Information Technology

JSP	Joint Services Publication
KPP	Key Performance Parameter
KSA	Key System Attributes
LCC	Life Cycle Cost
LCSP	Life Cycle Sustainment Plan
LIMS	Logistic Information Management Systems
LSE	Lead System Engineer
ML	Material Logistic
MOD	Ministry of Defence
MOU	Memoranda of Understanding
NATO	North Atlantic Treaty Organization
NET	New Equipment Training
O&S	Operations and Sustainment
OJT	On-the-Job Training
PEMA	Portable Electronic Maintenance Aides
PHS&T	Packaging, Handling, Storage and Transportation
PM	Program Manager
PSA	Product Support Analysis
PSE	Peculiar Support Equipment
PSM	Product Support Manager
PSMFA	Product Support Management Functional Authority
PSS	Product Support Strategy
S&TE	Support and Test Equipment
SC	Steering Committee
SME	Subject Matter Expertise
SPO	System Program Offices
TADSS	Training Aids Devices Simulators and Simulations
TLS	Through-Life Support
TM	Technical Manuals
TOC	Total ownership costs
US	United States
WG	Working Groups

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