

SPC INGENIEROS

A Comprehensive Approach to Integrated Product Support

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ABSTRACT

Integrated Product Support (IPS) is a systematic methodology designed to optimize the life-cycle cost (LCC) of products by integrating support considerations into the earliest phases of design.

Originally developed for military applications, IPS has been widely adopted in commercial sectors due to its effectiveness in reducing operational and maintenance costs while enhancing product usability.

This paper explores the historical evolution of IPS, its core disciplines, and its critical role in modern customer service strategies.

The discussion highlights how IPS aligns with international standards and contributes to sustainable product management from conception to disposal.

INTRODUCTION

Integrated Product Support (IPS) is a holistic approach that ensures all support elements are derived from a unified set of requirements and design analyses.

By addressing logistics, maintenance, training, and other support needs early in the product lifecycle, ILS minimizes costs and maximizes operational efficiency. Initially rooted in military standards such as MIL-STD and DEF STAN, ILS has evolved into a cross-industry best practice, particularly in aerospace, defense, and commercial sectors.

HISTORICAL EVOLUTION OF IPS

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Furtherly, ILS evolved to IPS...

Early Stages (Pre-1970s)

Before ILS, support systems were fragmented:

- Manufacturers owned production lines and supplied spare parts directly.
- End-users handled repairs independently.
- Technical manuals were rudimentary, often repurposing design drawings.
- Training was ad hoc, conducted by engineers from design teams.

After-Sales Support (1973–1985)

Organizations began centralizing support functions to address post-delivery issues. Key offerings included:

- Technical publications (manuals).
- Spare parts logistics.
- Training programs.
- Component repair services.

Limitation: Support was entirely product-sales-driven.

Product Support Concept (1985–2000)

Support organizations adopted concurrent engineering, integrating new disciplines:

- RMT (Reliability, Maintainability, Testability).

- Logistic Support Analysis (LSA).
- Level of Repair Analysis (LORA).
- Ground Support Equipment (GSE).

Two new domains emerged:

- Integrated Logistic Support (ILS).
- Supportability Engineering.

By 2000, over 50% of offers included support and service requirements.

Customer Services Concept (Post-2000)

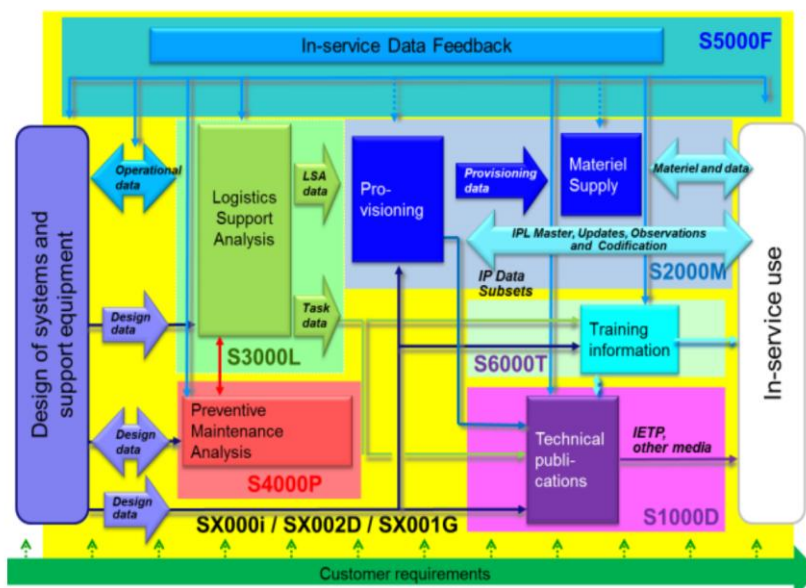
A customer-centric model prioritized operational and maintenance needs, introducing:

- Fixed-price maintenance contracts.
 - Performance-based logistics (e.g., pricing tied to usage parameters).
 - Non-product services (e.g., warehouse management, training systems).
- Result: 75% of offers were support-related, reflecting ILS's strategic value.

CORE IPS DISCIPLINES

IPS comprises 11 key disciplines, each of them critical to reducing LCC:

- **Technical Support:** Ensures design integrity and continuous improvement.
- **Maintenance Support:** Combines preventive, predictive, and corrective maintenance (e.g., ISMO optimization).
- **Material Support:** Manages spare parts, repairs, and supply chains.
- **Training & Training Aids:** Develops skills for operation and maintenance.
- **Technical Data:** Standardized documentation (e.g., S1000D for technical manuals).
- **Manpower & Personnel:** Aligns human factors with support tasks.
- **Facilities:** Designs infrastructure for operations (e.g., workshops, garages).
- **Packaging, Handling, Storage & Transport (PHS&T):** Ensures safe logistics.
- **Support & Test Equipment:** Specifies tools for maintenance and testing.
- **Computer Support:** Covers IT systems for operational and maintenance software.
- **Disposal:** Complies with environmental standards (e.g., ISO 14001) for system retirement.



- Product Support Management: S8000F
- Technical Data: S1000D
- Material Management: S2000M
- Logistic Support Analysis (LSA): S3000L
- Preventive Maintenance: S4000P
- Sustaining Engineering: S6000T
- Training: S8000F

Overview of the 5-Series IPS specifications (ILS-C-2013-002, Issue No. 6.0)
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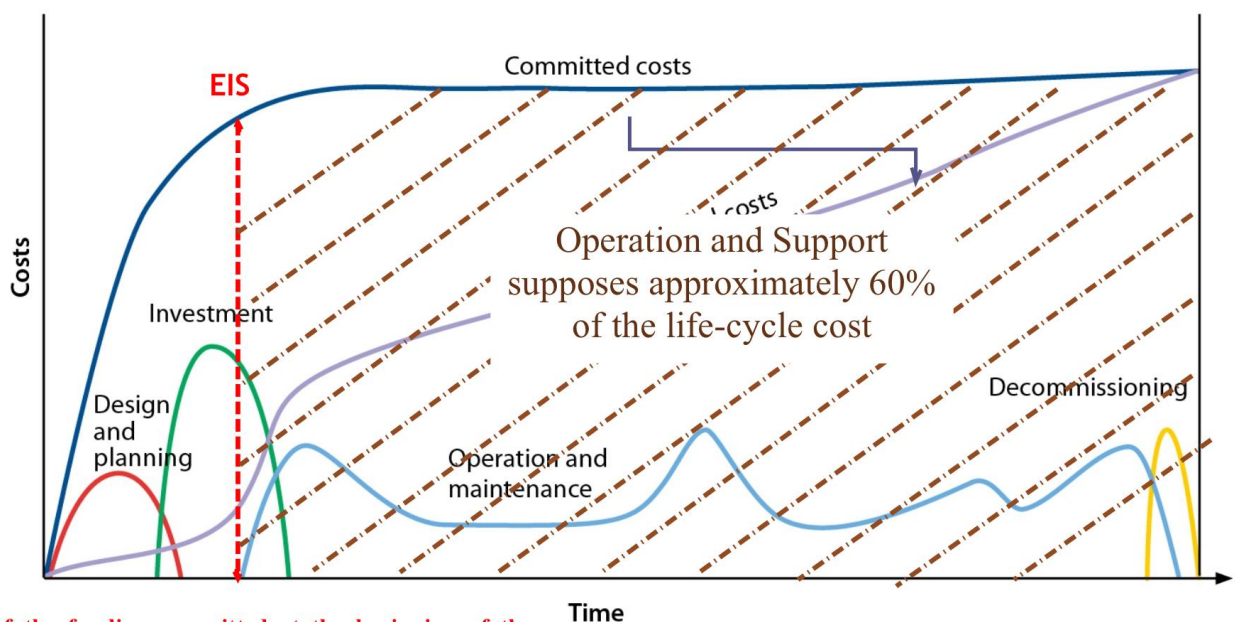
IPS ACROSS PROJECT PHASES

- **Concept:** Define support requirements.
- **Design:** Optimize for serviceability (e.g.: Design to Service).
- **Production:** Acquire support resources.
- **Service:** Maintain and improve systems.
- **Disposal:** Manage environmental impact.

THE PROJECT COST CURVE

- 60% of LCC is attributed to operation and support.
- 25% stems from acquisition,
- 15% from design and production.

Early stages of ILS activities mitigates costs by influencing design decisions.



Most of the funding committed at the beginning of the project, even with design is not frozen

STANDARDS

Military standards (MIL-STD) laid ILS’s foundation, but industries now adopt “Integrated Product Support (IPS)” specifications.

Collaborative efforts by *ASD* (Aerospace and Defence Industries Association of Europe) and *AIA* (Aerospace Industries Association) aim to unify IPS for civil and military applications.

CASE STUDIES: IPS IN PRACTICE

Military Aerospace: F-35 Lightning II Program

Challenge: The F-35’s global supply chain and complex maintenance requirements risked high life-cycle costs.

ILS Solution:

- Implemented Performance-Based Logistics (PBL) contracts, tying supplier payments to availability metrics.
- Used “Logistic Support Analysis (LSA)” to optimize spare parts distribution across 15+ countries.
- Adopted S1000D for standardized technical manuals, reducing training time by 30%.
- Result: 20% reduction in sustainment costs (USD 1.2B saved annually) and 90% aircraft availability (Lockheed Martin, 2020).

Reference: U.S. Government Accountability Office (GAO). (2021). *F-35 Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost*. GAO-21-439.

Commercial Aviation: Airbus A350 XWB

Challenge: High operational costs due to fragmented support systems.

ILS Solution:

- Design to Service (D2S): Integrated maintenance access points during design (e.g., embedded sensors for predictive maintenance).
- Global Material Support Network: Real-time inventory tracking reduced AOG (Aircraft on Ground) incidents by 40%.
- Training Aids: Virtual reality (VR) simulators cut pilot training time by 25%.

Result: USD 50M annual savings in maintenance costs (Airbus Annual Report, 2022).

Reference: Airbus S.A.S. (2022). *A350 XWB Service & Support: Delivering Operational Efficiency*.

Defense: U.K. Royal Navy's Queen Elizabeth-Class Aircraft Carriers

Challenge: Sustain two 65,000-ton carriers with limited port infrastructure.

ILS Solution:

- Level of Repair Analysis (LORA)**: Centralized heavy maintenance in Rosyth Dockyard, reducing redundant facilities.
- Condition-Based Maintenance (CBM): IoT-enabled monitoring cut unplanned repairs by 35%.
- PHS&T Optimization: Custom containers for rotor blades reduced transport damage by 90%.

Result: GBP 120M saved over 10 years (U.K. Ministry of Defence, 2023).

Reference: National Audit Office (NAO). (2023). *Managing the Costs of the Queen Elizabeth-Class Carriers*. HC 1129.

Rail Transport: Deutsche Bahn ICE Trains

Challenge: Aging fleet led to rising delays and part shortages.

ILS Solution:

- Reliability-Centered Maintenance (RCM)**: Prioritized components with highest failure rates (e.g., brake systems).
- 3D Printing for Spares: On-demand manufacturing reduced lead times by 70%.
- Standardized Technical Data: Deployed S1000D for maintenance docs, improving technician efficiency.

Result: 15% increase in fleet availability (Deutsche Bahn Technical Report, 2021).

Reference: Deutsche Bahn AG. (2021). *Digital Maintenance Strategy for High-Speed Trains*.

Space: NASA's James Webb Space Telescope (JWST)

Challenge: Zero-failure tolerance for a 1.5M km-distant telescope.

ILS Solution:

- Testability Engineering: 100% of ground support equipment (GSE) was validated via LSA.
- Disposal Planning: Fuel depletion maneuvers ensured safe orbit retirement per ISO 14001.

Result: 20+ year operational life with zero maintenance interventions (NASA JPL, 2022).

Reference: NASA. (2022). *JWST Integrated Support Plan*. JPL D-102195.

CONCLUSION

IPS is a transformative methodology that:

- Reduces LCC by up to 60% through early support integration.
- Enhances customer satisfaction and competitive advantage.
- Aligns with global sustainability goals (e.g., disposal standards).

Future success depends on embedding IPS in organizational culture and leveraging digital tools (e.g., predictive maintenance analytics). As industries prioritize lifecycle efficiency, IPS will remain pivotal in bridging design, operation, and environmental stewardship.



These case studies demonstrate IPS's versatility across industries:

- Military: PBL and LSA drive cost savings (F-35).
- Commercial: D2S and predictive maintenance enhance efficiency (A350).
- Public Infrastructure: RCM and 3D printing mitigate aging fleets (Deutsche Bahn).

Future Trends: AI-driven LSA and circular economy principles (e.g., reuse in disposal) will further optimize ILS.

REFERENCES

- ASD S-Series ILS Specifications.
- ISO 14001:2015 (Environmental Management).
- Martínez García, J. A. (EADS-CASA/EOI). *Integrated Logistic Support*.
- US Defense Standardization Program (DSP).
- Lockheed Martin. (2020). *F-35 Global Sustainment Metrics*.
- U.K. MoD. (2023). *Defence Support Strategy: Delivering Readiness*.
- ISO. (2015). *ISO 14001: Environmental Management Systems*.

KEYWORDS

ILS, Life-Cycle Cost, Product Support, Maintenance Optimization, IPS.