

Recommended Practice

Recommended Practice for Parts Management

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Recommended Practice for Parts Management

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Abstract

This AIAA standard establishes a parts management approach that is consistent with today's business environment. This Recommended Practice, as viewed by industry and government, is a shift in business philosophy from a controlled approach to a performance-based process. The dynamic growth of the commercial market for electronic parts as well as corresponding decrease in aerospace and defense have caused the government and industry to seek alternative methods of managing parts. To develop a solution to this complex problem, industry and government teamed to develop this Recommended Practice for mitigating potential problems/risks. The result of this team effort is a non-government standard (NGS) on Parts Management. The basic strategy employed by this document is to understand and manage risk as early as possible in program life cycle.

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Foreword

This Recommended Practice for Parts Management has been reviewed and approved by the American Institute of Aeronautics and Astronautics as part of its Standards Program. In 1995, an industry organized consortium took the initiative to respond to a critical need and then approached the AIAA to achieve broader circulation and demonstration of consensus. In 1996, the document was proposed as an ISO International Standard within ISO TC20/SC14, Space Systems and Operations. Publication of that effort is imminent, but the scope is restricted to electrical, electronic, and electromechanical (EEE) parts used in space systems. This 2001 revision draws from the improvements made during the international discussions, but maintains the broad application to mechanical parts, as well as EEE and in a broader industry setting. The data in Section 1 has also been brought up-to-date.

The Department of Defense (DoD) has adopted this Recommended Practice informally through its acquisition reform program. The challenge to the aerospace and defense industry during the on-going, changing business environment still calls for the use of performance and commercial specifications with a baseline that ensures the performance, reliability, cost competitiveness, life-cycle projections, on-time delivery, manufacturing process controls, and long-term viability of parts and materials.

The original industry/government Part Acquisition Reform Team (PART) that developed this performance-based Recommended Practice to replace military specifications for parts and materials management is maintaining it.

The AIAA Standards Program Procedures provide that all approved Standards, Recommended Practices, and Guides are advisory only. Their use by anyone is entirely voluntary. There is no advance agreement to adhere to any AIAA standard publication and no commitment to conform to or be guided by any standards report. In formulating, revising, and approving standards publications, the Committees on Standards are responsible for protecting themselves against liability for infringement of patents or copyrights or both. This AIAA document is a voluntary standard. It becomes binding only when two parties agree to use it or parts thereof in a contract.

The AIAA Reliability Committee on Standards, including the Part Acquisition Reform Team, composed of the following individuals, approved the revision in April 2001:

John P. Gartin, Chairman, DeMac Enterprises

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1 Introduction

1.1 Scope

This Recommended Practice is a collection of techniques for managing parts programs. It addresses the preferred program elements adopted by the aerospace industry (military, civil, and commercial) for parts management. The approaches cover electrical, electronic, and electromechanical (EEE) and mechanical parts.

This document is written in general terms as a baseline for implementing a parts management program. It may be cited as a baseline within a statement of work and/or for assessing proposals and contractor performance. All levels of contractual relationships (acquiring activities, primes, subcontractors, and suppliers) may use this document. EEE and mechanical parts, together with materials and processes, form one of seventeen critical processes involved in the various phases of every program.

1.2 Purpose

The purpose of this Recommended Practice is to assist contractors in the development of a parts management plan. The user is responsible for integrating the elements of this Recommended Practice appropriate to the program.

1.3 Background

Diminishing sources of military and space parts are leading to the use of commercial parts which will result in substantial nonrecurring engineering (NRE) cost increases in current and future programs. The cost increases are incurred due to the need to establish a new reliability baseline through design, redesign, or modification of current systems, analysis, and test of systems and subsystems utilizing these commercial parts. The availability of radiation-tolerant/hardened parts is most at risk.

The trend of technology obsolescence and diminishing manufacturing sources of military and radiation-hardened parts, materials, and equipment has been rapidly escalating due to a relative decline in the defense market coupled with the explosive growth of the commercial marketplace. Within the microcircuit industry, for example, military sales have declined from 17 percent to less than 1 percent of the total market (Figure 1). This shrinking market has prompted an increase in the number of products discontinued each year (Figure 2). As a result, industry has increasingly focused attention on issues of parts obsolescence affecting current development and production programs. Life cycles of new microcircuit technologies are rapidly shrinking (Figure 3) and, in some cases, they are shorter than the time it takes to get a program through development into production. See annexes A, B, C, D, E, and F for more information.

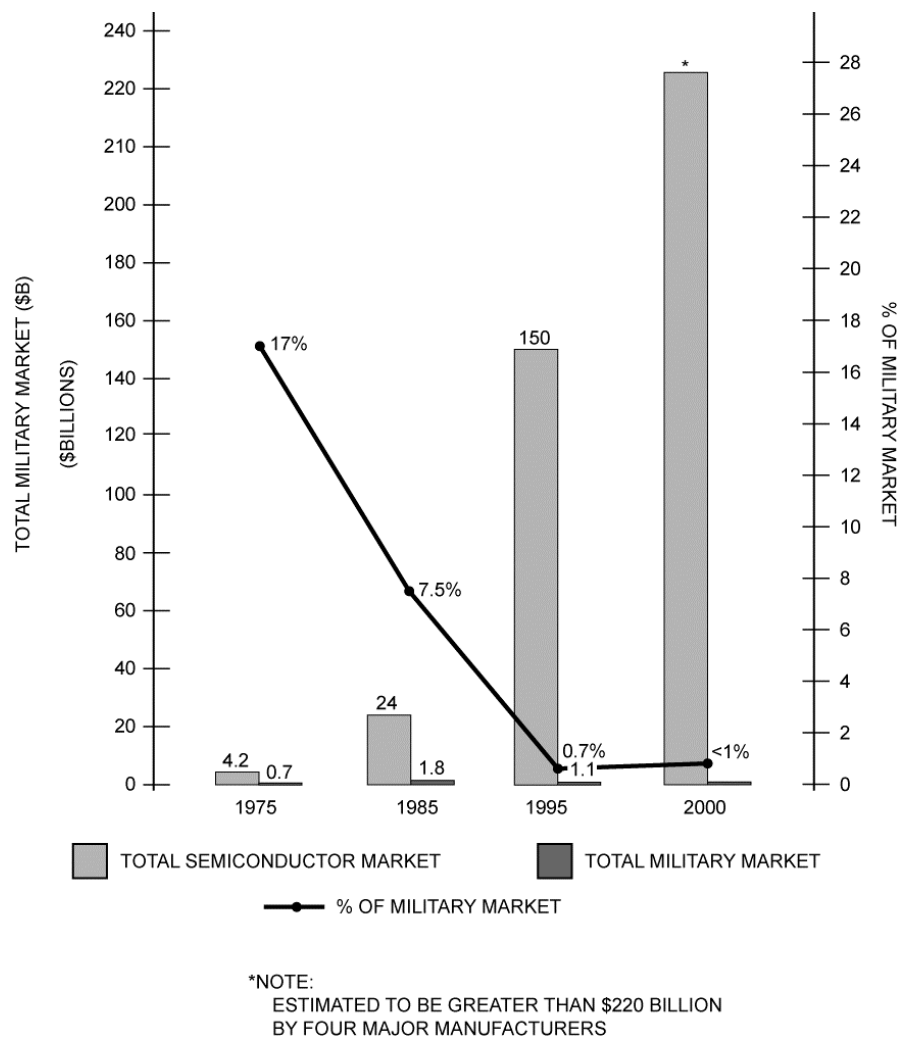


Figure 1. Declining military market share

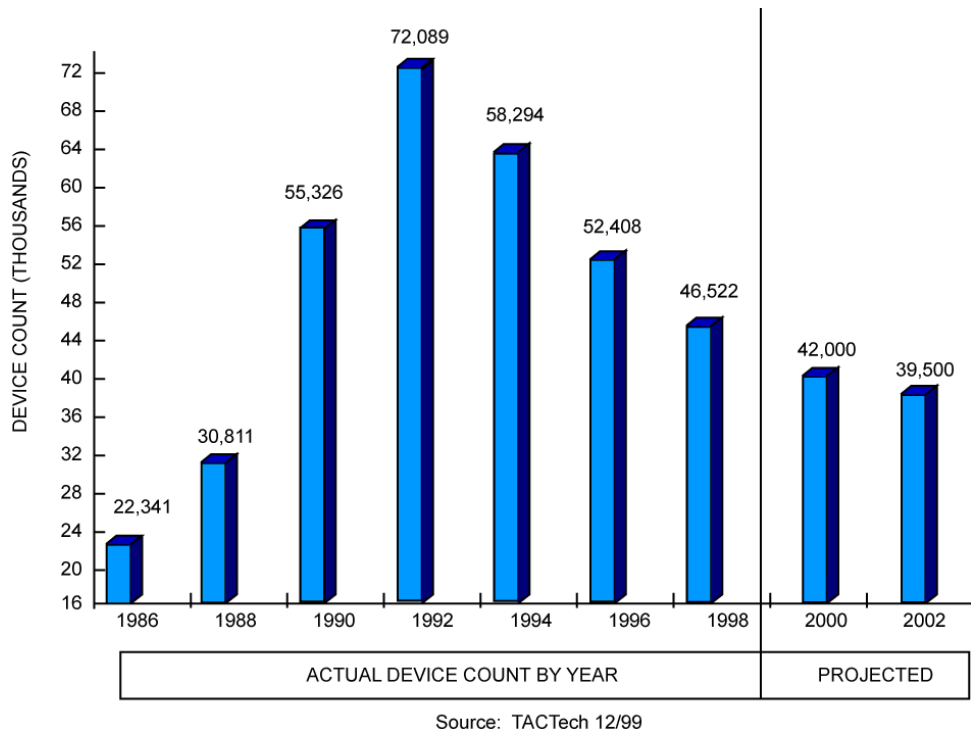


Figure 2. Declining military microcircuit availability

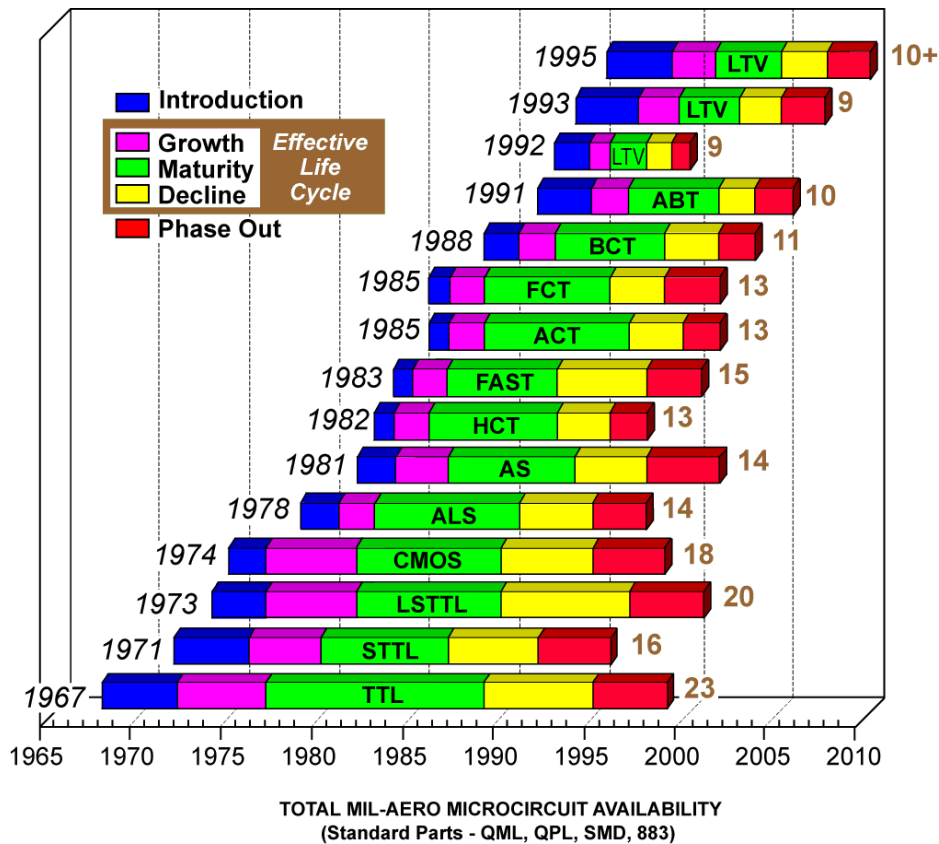


Figure 3. Reduction in technology life cycles

1.4 Summary

In order to establish a government/industry parts management program consistent with the new acquisition reform business environment and to address the issues and objectives noted previously, this Recommended Practice addresses the following ten key elements. A strategy policy for each element forms the foundation for a Parts Management Program.

- **Part Obsolescence Management** - minimize program disruption and ensure long-term supportability throughout the program life cycle.
- **Supplier Management** - establish teaming partnerships with key suppliers to improve delivery and lower cost.
- **Standard Supplier Assessments** - eliminate redundant efforts and nonvalue added evaluations (program-to-program, company-to-company exchange).
- **Cost** - realize significant cost reduction on existing and new programs.
- **Technology Insertion** - focus on utilizing technologies with lowest life cycle cost and maximum longevity.
- **Communication Information Exchange** - share contractor data via innovative concepts (electronic information systems).
- **Process Control** - validate supplier techniques for monitoring critical manufacturing processes
- **Insight/Oversight** - transition customer insight/oversight to integrated product team (concept (customer participation in the contractor's processes).
- **Concurrent Engineering** - encourage parts engineering participation in all phases of the product life cycle concept to past delivery.
- **Training** - establish program awareness throughout all levels of industry and government.

2 Vocabulary and Acronyms

2.1 Vocabulary

Best Practice A consensus document developed by industry and government integrated product teams (IPT's) to manage parts, materials, and programs.

IPT The integrated product team consists of members selected from the appropriate disciplines (e.g., component engineering, manufacturing, test, reliability, marketing, design).

IPT Product The product of the "best practice" design process is the bill of materials and documentation for the hardware described by the product specification

Part For the purpose of this Recommended Practice, a part can be a subassembly, discrete component, nondevelopmental item, commercial of the shelf, hybrid, etc.

Performance Specification A document that defines what the customer desires as a product, its operational environments, and all required performance characteristics. This specification defines the performance requirements, not how to achieve them.

Product Specification A document that defines the end item(s) the supplier intends to provide to satisfy all the performance specification requirements.

Standardization Provides industry commonality to reduce inventories, minimize life cycle costs, and ensure supportability through the use of shared qualification, reliability, performance assessments, and common technology selection criteria.

Supplier The entity that has a contractual obligation to provide parts, services, or materials (e.g., subcontractor, vendor, distributor, manufacturer, etc.).

Technology Insertion Strategy A decision making process to assess current and future part availability and technology trends, which leads to a decision regarding emerging or new technology insertion. This process is done in the concept development phase but also impacts the production and field support phases.

Validation Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled

NOTE – Review of applicable process and procedure documentation to determine hardware conformance to the design specific requirements developed during the design process is an essential element of the parts management process. This validation provides the baseline for future change evaluation and performance improvement monitoring. Multiple validations may be carried out if there are different intended uses. Validation is normally performed on the final product under defined operating conditions. It may be necessary in earlier stages, such as in design and development. Validation concerns the process of examining a product to determine conformity with user needs. In essence the term ‘validated’ is used to designate the corresponding status of a product. (Reference ISO 9000:2000)

Verification Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled.

NOTE – In design and development, verification concerns the process of examining the results of a given activity to determine conformity with stated requirements for that activity. The term verified is used to designate the corresponding status of a product. (Reference ISO 9000:2000)

2.2 Acronyms

AIAA	American Institute of Aeronautics and Astronautics
ANSI	American National Standards Institute
ARN	Anticipated Reliability Number
ATP	Acceptance Test Procedure
BiCMOS	Bipolar Complimentary Metal Oxide on Silicon
BiMOS	Bipolar Metal Oxide on Silicon
BOM	Bill of Material
CAM	Computer-Aided Manufacturing
CD	Circuit Design
COTS	Commercial Off the Shelf
CMOS	Complimentary Metal Oxide on Silicon
DASIAC	DoD Nuclear Information Analysis Center
DEMP	Discharged Electromagnetic Pulse
DI	Dielectric Insulation
DM	Design Margin

DMSMS	Diminishing Manufacturing Sources and Material Shortages
DoD	Department of Defense
DOE	Design of Experiments
DPA	Destructive Physical Analysis
DRAM	Dynamic Random Access Memory
ECL	Emitter Coupled Logic
EEE	Electrical, Electronic and Electromechanical parts
EMC	Electromagnetic Compatibility
EMP	Electromagnetic Pulse
ERRIC	Electronic Radiation Response Information Center
ESD	Electrostatic Discharge
F ³ I	Form, Fit, Function Interfaces
GIDEP	Government Industry Data Exchange Program
HA	Hardness Assurance
HAST	Highly Accelerated Stress Test
HEMP	High Altitude Electromagnetic Pulse
IPT	Integrated Product Team
Kpsi	Thousand pounds per square inch
LSTTS	Low Schottky Transistor Transistor Logic
MCM	Multichip Module
MOS	Metal Oxide Semiconductor
MP	Mission Profile
NDI	Nondevelopmental Item
NGS	Nongovernmental Standard
NRE	Nonrecurring Engineering
Ns	Nanosecond
PART	Part Acquisition Reform Team
PEM	Plastic Encapsulated Microcircuit
PPSL	Preferred Parts Selection List
PS	Parts Selection

PWB	Printed Wiring Board
RLAT	Radiation Lot Acceptance Test
RE	Recurring Engineering
S	Sensitive
SEB	Single Event Burnout
SEE	Single Event Effects
SEGR	Single Event Gate Rupture
SEL	Single Event Latchup
SEU	Single Event Upset
SGEMP	Systems-Generated Electromagnetic Pulse
SH	Shielding
SMT	Surface Mount Technology
SPC	Statistical Process Control
SOS	Silicon on Sapphire
T	Tolerant
TBD	To Be Determined
TTL	Transistor Transistor Logic
WWW	World Wide Web
° C	degrees Celsius

3 Parts management process

This Recommended Practice was developed to assist in dealing more proactively with critical parts and materials management issues and to provide guidance for developing comprehensive strategies to manage cost and schedule risk via an Integrated Product Team process (Figure 4). The main aspects of the Parts Management Process are: Design Process, Supplier Management, and Shared Data. The design process includes, but is not limited to, design margins, life cycle cost, technology insertion strategy, technical support, parts selection, and validation, which are addressed concurrently rather than sequentially. Supplier Management proactively selects and monitors the supplier base, while information generated from the design process and supplier management process is organized in a database that is shared with IPT members for the purposes of reducing cost and improving schedule performance.

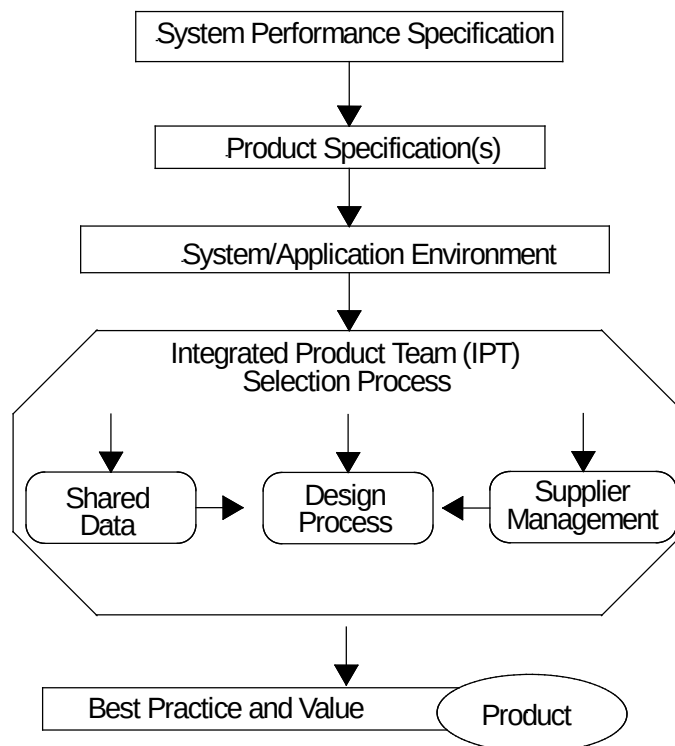


Figure 4. Parts management IPT overview

3.1 Design process

The flow diagram (Figure 5) illustrates the interrelationships of the critical key elements that must be addressed concurrently by engineering and Supplier Management (B) to achieve the “best practice” selection of parts, materials, and documentation required for the design. The results obtained from analysis within some of the key elements should be made available as Shared Data (A). (Refer to Section 3.3). The following paragraphs describe these key elements.

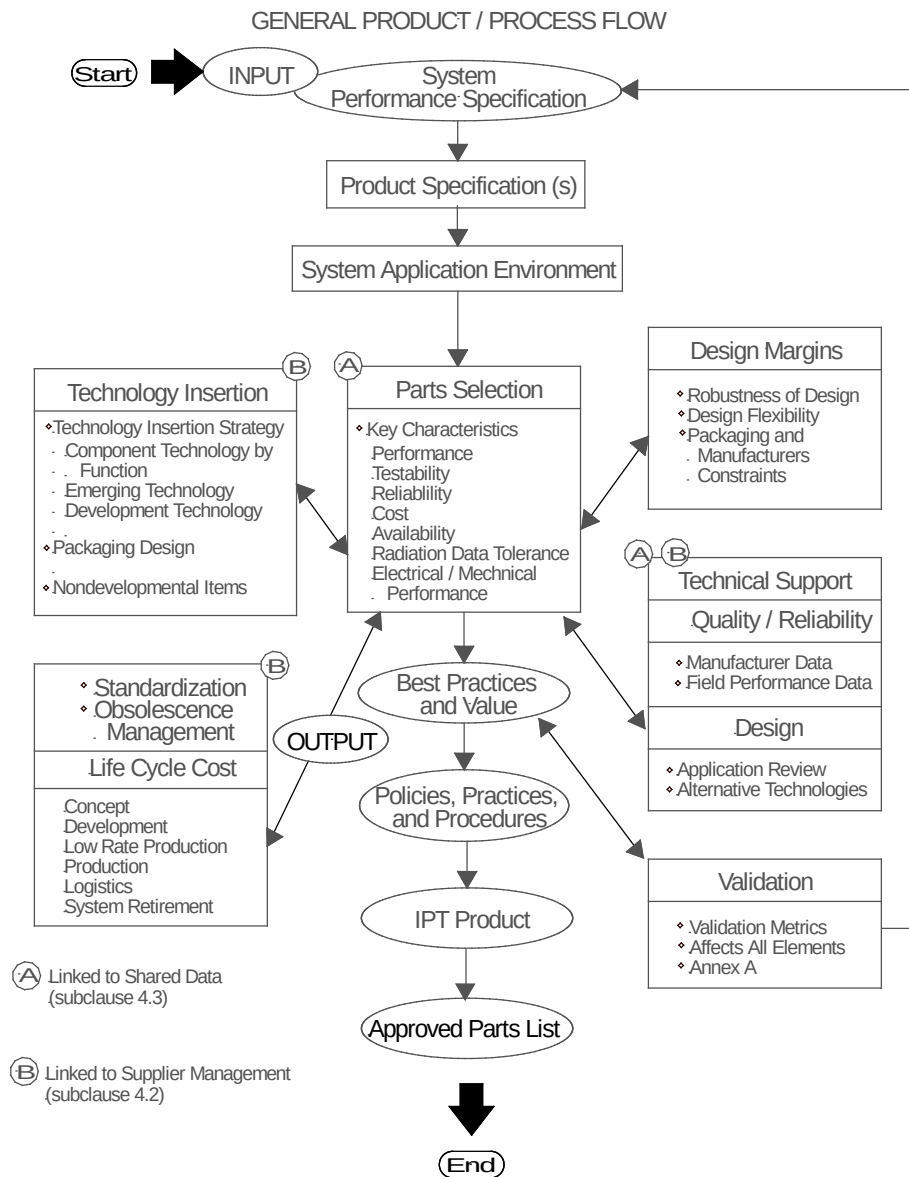


Figure 5. Design process

3.1.1 Design margin

The objective is to assist Integrated Product Teams with critical analyses resulting in a robust design and minimized life cycle cost. The availability of computer-based analysis and simulation tools presents the opportunity to validate the detailed aspects of a design prior to manufacturing/qualification commitment. A design margin analysis based on actual conditions will combine a comprehensive description of piece part characteristics with simulation to ensure that system performance characteristics will be appropriate for the specific application.

The design margin process (Figure 6) describes a minimum set of analyses to maximize design robustness. Metrics to validate the process include but are not limited to the following:

- Comparisons of actual design margins to established baselines
- Quantity of engineering design changes
- Qualification test performance (failures)
- Yield prediction analysis (Cpk)
- Manufacturing/production yields [acceptance test procedure (ATP)]
- System/Application/Environment

Associated elements are:

- Parts Selection (Section 3.1.5)
- Technical Support (Section 3.1.4)

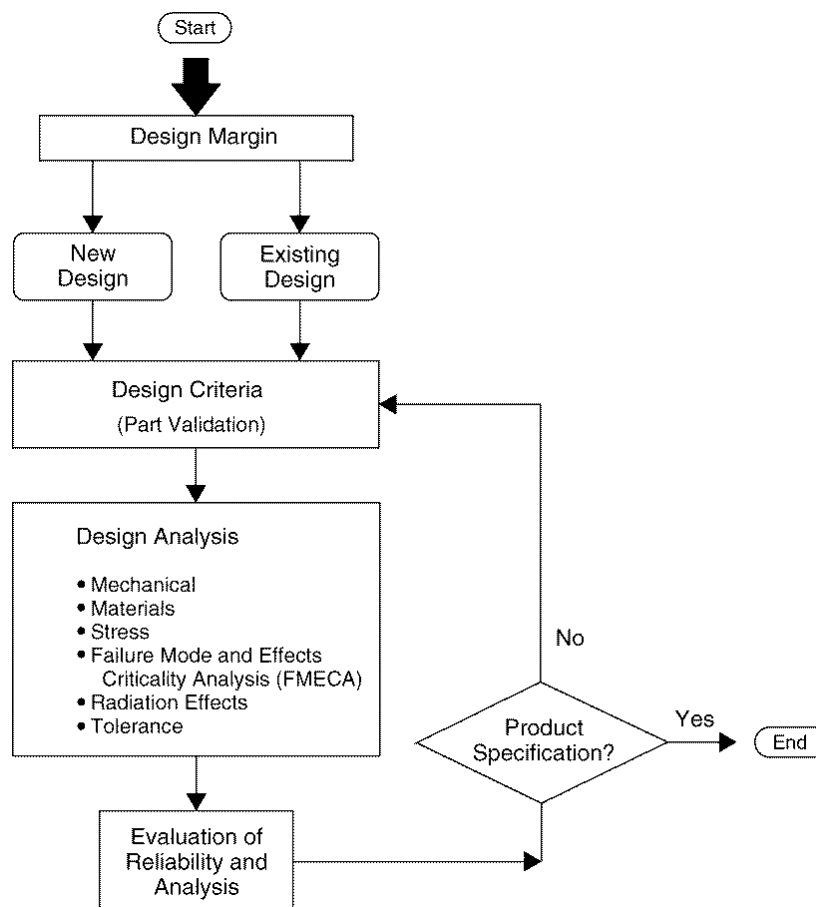


Figure 6. Design margin

3.1.2 Life cycle cost

The objective is to provide methods for parts and materials standardization, to identify technology assessment strategies and risk mitigation procedures to minimize program disruption due to part and material obsolescence, and to define baselines to minimize costs throughout program life cycles (Figure 7).

Standardization techniques are becoming increasingly dependent on the available supplier base and market trends. New innovative ideas to move away from part and material number standardization to commodity/technology/family standardization provide a lower cost/higher benefit approach.

Factors to be considered include technology maturity, market base, material cost, ease of manufacture, performance management, qualification parts, material, and processes, logistics costs, standardization and form, fit, function interfaces (F³I). Initial nonrecurring costs must be de-emphasized and rationalized with long-term cost savings to provide the best value to the customer.

Through the implementation of technology assessments, strategic supplier relationships, technology leapfrogging, and creative risk mitigation techniques, program continuity can be maintained and life cycle costs can be minimized.

Validation of the life cycle cost objectives can be accomplished through the use of the following methods:

- Trade studies documenting part and material selection during design including all elements of cost versus lifetime performance through all program phases.

- Periodic program part and material technology assessments of life cycle ratings for obsolescence management.
- Periodic price trend analyses for “road map” technologies to validate that costs are declining as the technologies move from introduction and growth to production maturity in the market.
- Cost associated with qualification

Associated elements are:

- Parts Selection (Section 3.1.5)
- Technology Insertion Strategy (Section 3.1.3)

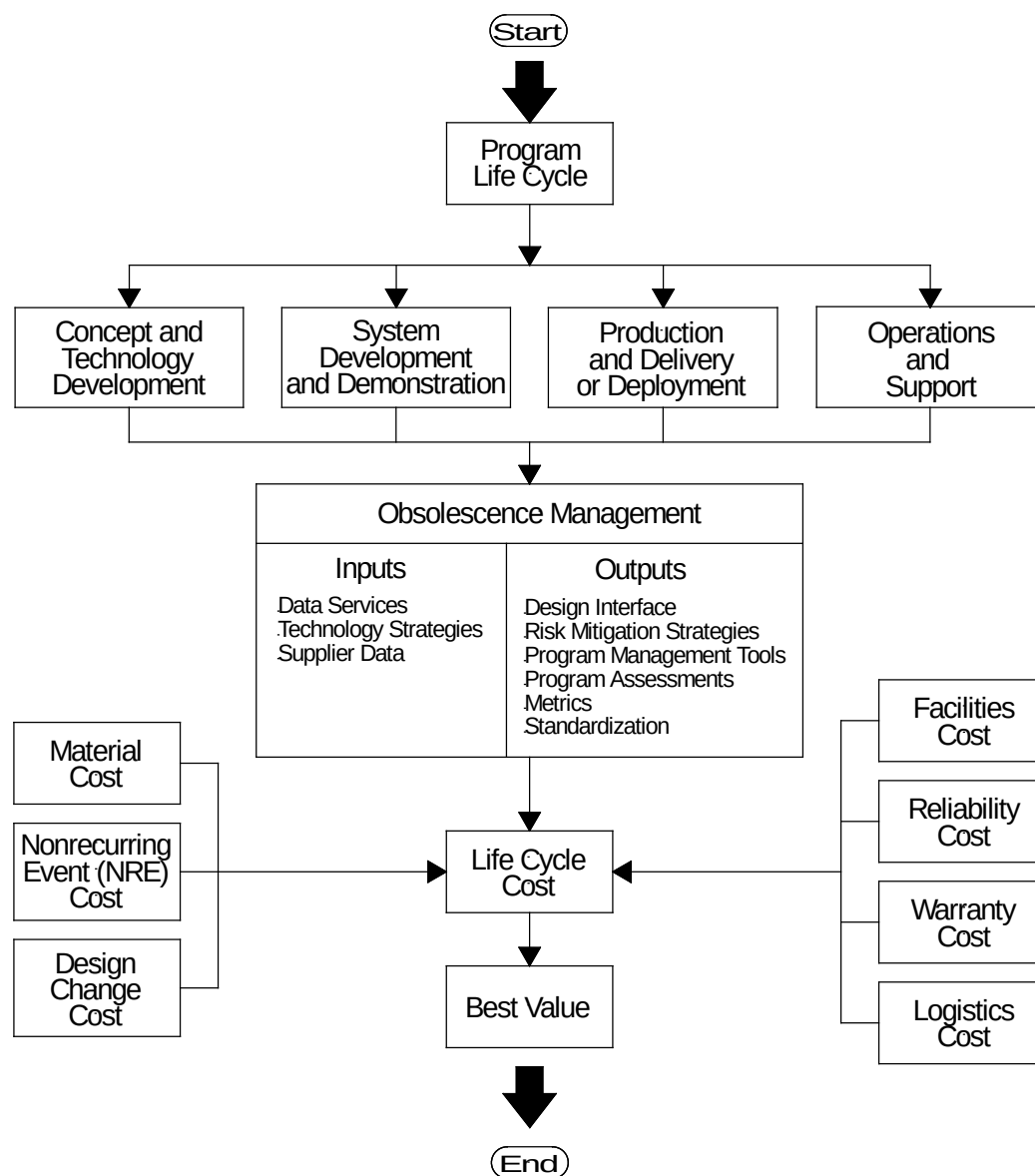


Figure 7. Life cycle cost

3.1.3 Technology insertion strategy

The objective is to create technology road maps which minimize risk of obsolescence and develop a strategy for technology insertion during the entire life cycle (Figure 8). The commercial industry is driving new technology development of parts and materials. The market dynamics of the industry (availability, functionality, performance, characteristics, and packaging) affect the way parts and materials are used in the design. Technology road maps subdivide technologies into functions that provide the required visibility to resolve future obsolescence and standardization issues. Use of technology road maps is the key element of the parts and materials selection process. Technology road maps must be assessed over the life of the program to validate their effectiveness.

Associated elements are:

- Design Margin (Section 3.1.1)
- Life Cycle Cost (Section 3.1.2)
- Parts Selection (Section 3.1.5)

3.1.4 Technical support

The management activity should provide data to facilitate reliability analysis, monitor applications, identify risk issues, and suggest mitigation paths associated with the selected parts and materials (Figure 9). Accomplishment of the performance objectives will be enhanced through the application of user and field reliability information from Shared Data. The Shared Data and Supplier Management information should be used in support of the IPT for evaluating sourcing, performance, packaging, and availability. Reliability models must be assessed over the life of the program to validate their effectiveness.

Associated elements are:

- Design Margin (Section 3.1.1)
- Parts Selection (Section 3.1.5)
- Shared Data (Section 3.3)

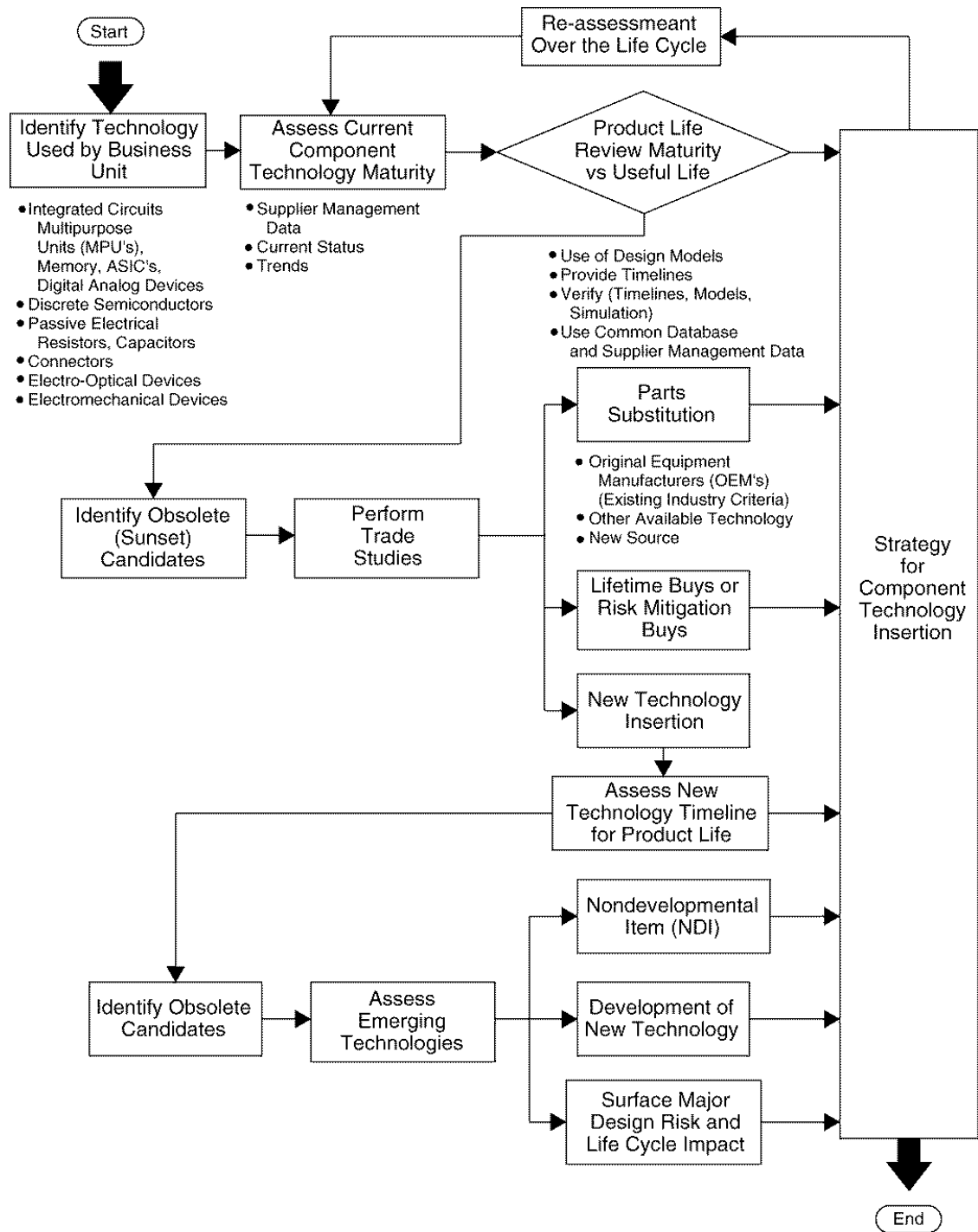


Figure 8. Technology insertion strategy (road map)

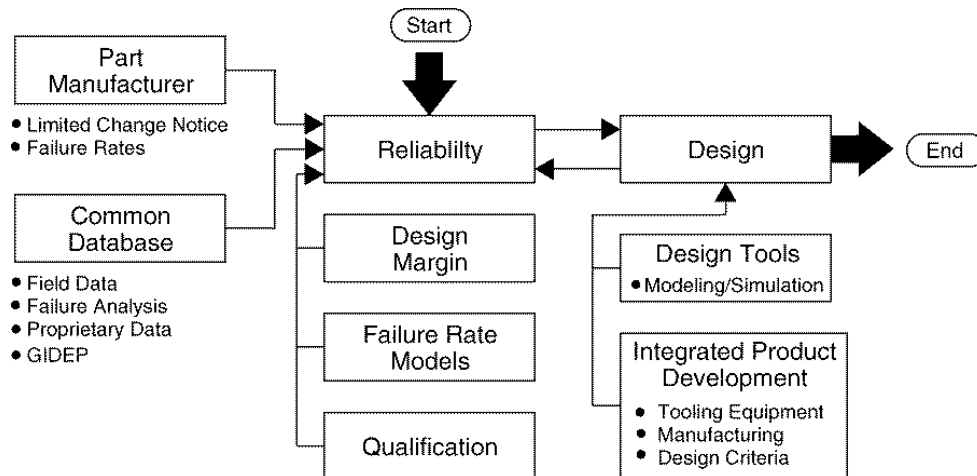


Figure 9. Technical support

3.1.5 Parts selection

In selecting parts, the objective is to evaluate inputs from all key elements and then select the parts that satisfy the product specification (Figure 10). The Selection Process is based on determining and assessing the key characteristics of the parts and materials that are under consideration. The process uses existing industry, government and supplier databases, as established and, where necessary, performs characterization testing. The selection should be made after assessing testability, reliability, radiation tolerance (Annex D), availability, cost, and performance, as appropriate.

Validation of the selection objectives can be accomplished through the use of a checklist (Annex A), which ensures completeness of the selection data and results in a best practice product.

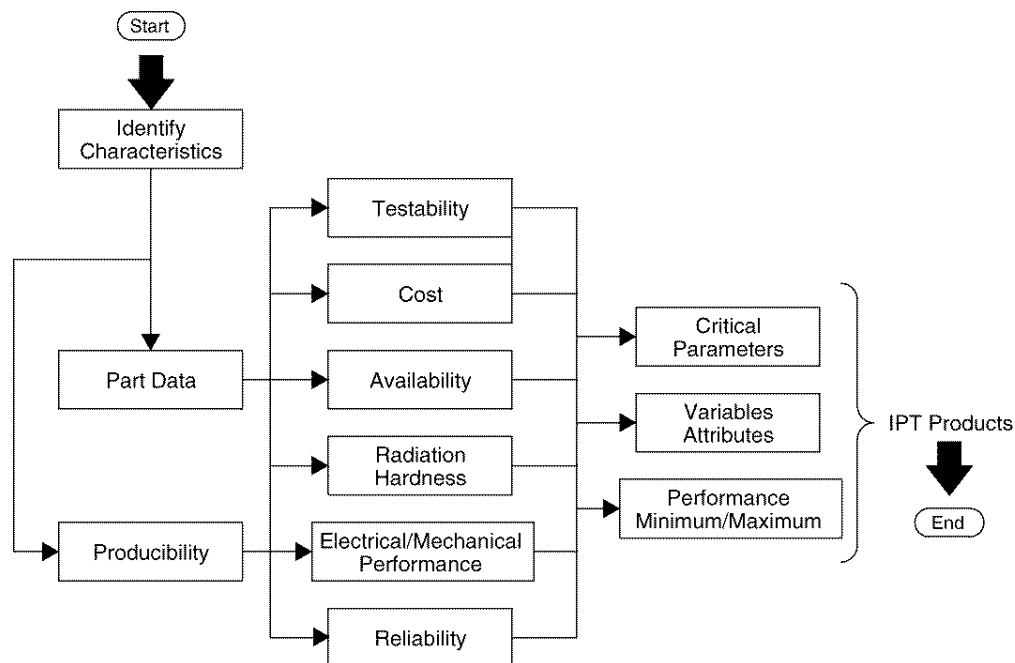


Figure 10. Parts selection