PRODUCT MANAGEMENT PLAN - SOURCING HARD-TO-FIND OBSOLETE PARTS WITH VALUE ADDED SERVICES

Celebrating Over 35 Years of Working with DoD Customers

Matt Bergeron / Sultan Lilani

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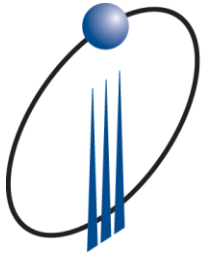
Agenda

- Definitions and Problem outline
- Risks
- Various Solutions

Part #1

Definitions

Matt Bergeron



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Definitions

Sourcing EEE Devices (Supply Shortage – Could be obsolete)

- The practice of locating and selecting EEE devices that meet the FFF(Form Fit Function) requirements or can be upgraded to meet FFF requirements .

Obsolete

- One can define obsolescence as the process of becoming outdated and no longer used.
  - Part is obsolete and not available in market - obsolescence
  - Material shortage and diminished availability – not obsolescence
  - Part shortage – demand outstrips the supply – not obsolescence
  - Shortage of supplies is not obsolescence

Some Solutions to Sourcing And Life Cycle Material Sustainment / Supply Shortage May be Same But They Are Not the Same As Obsolescence Management

Definitions

Hard-To-Find

- The practice of locating and selecting EEE devices that meet the FFF(Form Fit Function) requirements or can be upgraded to meet FFF requirements
- Unavailable
- Long lead times
- Inaccessible
- Inconvenient
- Unattainable or
- Unobtainable
- Could be obsolete
- Same quality or FFF is not available

Supply crunch means longer wait time for components *(Lead time)*

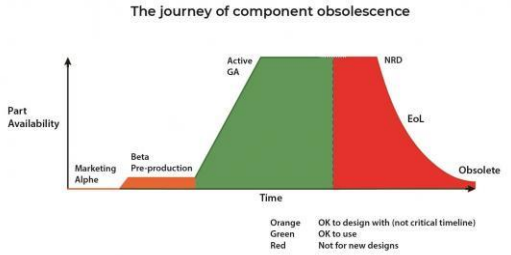
Category	Currently	Normally
Power management chips	24-52 weeks	4-8 weeks
Microcontroller chips	24-52 weeks	4-8 weeks
CPUs *(Central processing units)*	12-16 weeks	4-8 weeks
Memory chips	14-15 weeks	4-8 weeks
Wi-Fi chips	24-30 weeks	4-8 weeks
Consumer LCD screens	16-20 weeks	12 weeks
Substrate materials	52 weeks	20 weeks
Chip packaging services	12 weeks	2-4 weeks

Source: Nikkei Asia analysis of companies' data

Why Products Get Obsolete?

We Need to Understand Types of Obsolescence First Before We Can Find a Solution

- Technological Obsolescence
  - Technology is obsolete and does not allow supply chain to continue
  - Generation change (Moore's Law)
- Fit Obsolescence
  - The device functionality has changed and will not support the project need
- Legal Obsolescence
  - IP expiration, non-renewal of IP or manufacturing agreement
- Form Obsolescence
  - Example: parts are not available in same package
- ROI Obsolescence
  - Cannot produce the device profitably / low volume



Why Products Could be Hard-To-Find?

We Need to Understand Types of Obsolescence First Before We Can Find a Solution

- Part has become obsolete – no more manufacturing
- Components to manufacture are hard-to-find
- Demand outstrips supply
- Cost has gone high
- Hoarding
- Etc.

Source: World Semiconductor Trade Statistics Bluebook sales data, 2020-2019

Key Recognition: In majority of cases, hard-to-find products at some point were amply available

The DoD is Concerned about Obsolescence and Hard-To-FIND Parts

- **Up to 70 percent of electronics are obsolete prior to system fielding and one component may become obsolete 5-10 times during a weapon system's life cycle.**

- **Diminishing Manufacturing Sources and Material Shortages describes the loss of resources and materials needed to build, maintain and operate warfighting equipment.**

- **Facts to Consider:**
  - Devices Keep Getting More Complex.
  - OCMs Are Not Actively Participating in Obsolescence Management & Obsoleting parts quickly
  - No wide spread strategy to enable 3rd party EOL manufacturing
  - The Counterfeit Problem is Not Going Away Anytime Soon.
    - Complex devices are being more frequently counterfeited.
    - Traditional counterfeit detection techniques are no longer adequate to identify complex counterfeits.
    - Counterfeiters are more sophisticated than enforcers in most case.

- **Early Engagement Will Save Programs Millions in the Long-run**

Prime Example – the B-52

- Built to carry nuclear weapons for Cold War-era deterrence missions, the B-52 has been in active service with the USAF ***since 1955***. As of June 2019, 58 are in active service.

- Semiconductors change more rapidly than hit songs. The latest and greatest in the realm of military electronics can't change quite so rapidly. Aircraft like the B-52, as well as the F-15, 16, 18 and others, are based on old designs that frequently **contain 20- or 30-year-old avionics and weapons systems**.

- In many cases, these electronic systems are still quite functional and deadly; they just need to be maintained properly. But the ICs used in the original equipment have **long since dropped from production**.

Obsolescence is a driver of Operational & Sustainment Costs

- DefenseNews
  - **Report warns US Army to watch out for creeping operational costs with future helos**
  - "Since previous rotary-wing system programs are most closely related to the kinds of systems likely to be acquired for the FARA and FLRAA programs, O&S costs for FVL are likely to be more than 40 times larger than the FVL R&D costs and more than two times larger than FVL production costs," the authors determined.
- Military Embedded Systems
  - The problem of obsolescence is very prevalent in microelectronics technology as the life cycles for microelectronic parts are often in conflict with equipment life cycles. In addition, microelectronics technology has a long history of obsolescence issues.
  - **Semiconductor market today:**
    - DoD less than one percent of the semiconductor market
    - Average consumer life cycle 2-5 years maximum
    - All digital products are unique, silicon through packaging
    - Process technology development driven primarily by portable markets (low voltage, reduced temperature range, consumer life cycle)

PMP Key Features

Integra Will Buy the Parts

- Buy product from franchised distributors
- Inventory management and kitting
- Forecast management

Integra Will Support Value Added Services With Single PO

- Write SCD / SIDs / VIDs *
- Incoming Inspection *
- DPA *
- Assemble die in package of choice
- Upscreening *
- Qualification *
- Failure Analysis (Both Physical and Electrical) *
- Solder Dip (including BGAs) *
- Contact conversions (to and from lead)
- Tape / Reel *
- Dry Pack Bake *
- Out-going Inspection *

Integra Will Provide Kitting Services

- Release to order
  - Manage inventory

Parts Obsolescence Management

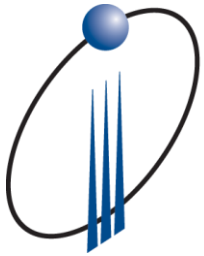
- Form Fit Function replacement
  - Re-design solution
  - Interposer
- Die procurement and assembly with QML assembly partners
- Buy EOL product and manage customer owned inventory
  - Short and Long Term Contract
- PCN/PDN – Integra supports this through our PMP program.
  - We work with franchised distribution (Arrow/Avnet) and have access to their PCN/PDN surveys. We manage this information and communicate to customer as required
- After market procurement of devices
  - Full authenticity investigation, qualification and testing

Customized Program per Customer Needs

Part 2

Risks of Obsolescence and Supply Shortages

Sultan Lilani



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Counterfeiters Are Taking Advantage of Hard-To-Find Parts

I. Counterfeiters were typically focusing on obsolete parts until now

II. With the shortage of supply chain, we are seeing counterfeiters are cloning high volume non-obsolete parts

III. Counterfeiters are also likely to provide used non-obsolete refurbished parts.

What's Worse Than a Chip Shortage? Buying Fake Ones

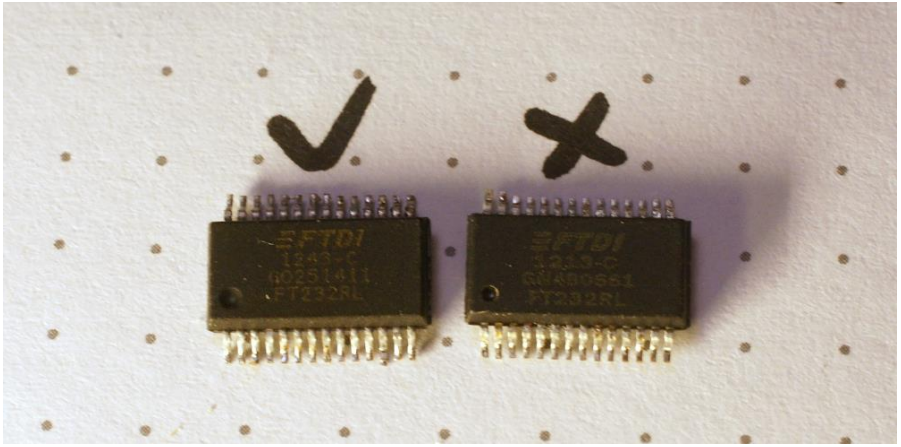
Global semiconductor shortage attracts fraudsters, counterfeits; 'Of course, a bunch of them didn't work,' a buyer says

WSJ Article – 7/15/2021

Counterfeiters Are Taking Advantage of Obsolescence

New Counterfeit Threats That Are Non-Recognizable By Conventional Detection Techniques

- Cloning
- Almost perfected micro-blast process
- New Non-detectable blacktop material



Types of Counterfeits

- Creation of a completely different p/n
- Remark change from RoHS or non-RoHS
- Remarking from commercial to Industrial
- Remarking from commercial to Mil-spec
- Remarking from Industrial to Mil-spec
- Remarking with speed upgrades
- Remarking of Die Rev
- Etc.

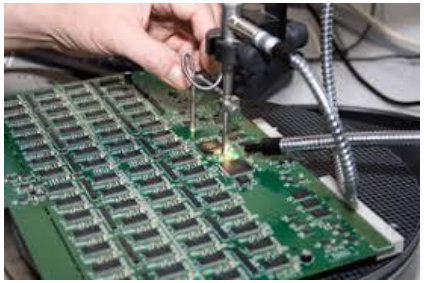
Conventional Visual Techniques May Not Work

- Conventional Optical Inspection
- However, SEM Shows Finer Details

Other Risky Approaches

- **Risky Re-work Process - Without Checking Long Term Reliability Considerations**
  - **General Market Consensus:** Rework can be acceptable for products which perform non-critical functions, or are part of a non-critical system
  - What part of a Mil/Aero system is non-critical?
- **Buying From Replacement Parts Manufacturer (RPM)**
  - Selling obsolete OEM parts under a new logo
  - Even have DLA official parts number

- **Must Verify Long-Term Reliability**

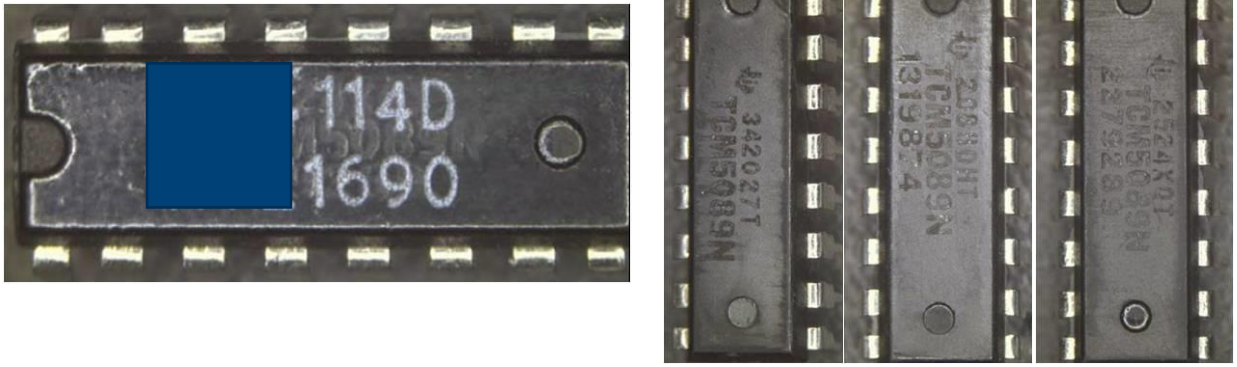


- **Must Verify Not Counterfeit**

“Replacement Parts” from “Authorized Distributors” Sold to Gov’t

Would you consider this a new part? (I don’t…)

- **Part number underneath is TCM5089N (Texas Instruments)**

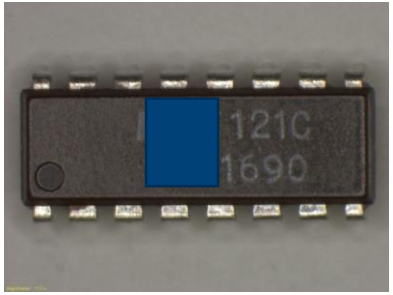


A typical part from an “RPM”

Source: NavyCrane and DLA

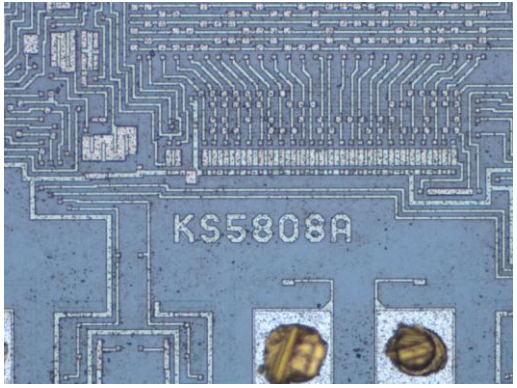
More RPM1690 parts from another source

RPM1690 equals (before Dynasolve test)…



Samsung reports the KS5808 “discontinued production a long time ago”.

Samsung KS5808 (after Dynasolve test)



Source: NavyCrane and DLA

“Replacement Parts” from “Authorized Distributors” Sold to Gov’t

After all, there is an RPM1690 data sheet…

[redacted]

[redacted]

Integrated Circuit
Telephone DTMF Dialer

Description:

The [redacted] is a monolithic integrated circuit in a 16–Lead DIP [redacted] CMOS process and is designed specifically for integrated tone diale

Features:

- High Accuracy Tones
- Digital Divider Logic, Resistive Ladder Network and CMOS Operati
- Uses Inexpensive 3.579545MHz Television Color Burst Crystal
- Invalid Key Entry Can Result in Either Single Tone or No Tone
- Tone Disable Allows Any Key Down Output to Function from Keyb Tones

Absolute Maximum Ratings: (T_A = +25°C unless otherwise specified)

Supply Voltage, V_{DD} 10.5V
Any Input Relative to V_{DD} (Except Pin10), V_N 0.3V
Any Input Relative to GND (Except Pin10), V_N ..... –0.3V
Power Dissipation, P_D 500mW
Operating Temperature Range, T_{opr} ..... –30° to +60°C
Storage Temperature Range, T_{stg} ..... –55° to +150°C

Electrical Characteristics: (–30°C < T_A < +60°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		3	–	10	V
Input “0”	V_{IL}		0	–	$0.3V_{CC}$	V
Input “1”	V_{IH}		$0.7V_{CC}$	–	V_{CC}	V
Input Pull–Up Resistor	R_I		20	–	100	KΩ

Rev. 3–12

Electrical Characteristics (Cont’d): (–30°C < T_A < +60°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Tone Disable	TD	Note 4	0	–	$0.3V_{CC}$	V
Tone Output	V_{OUT}	Note 1	–10	–	–7	dBm

Part 3

A View of Various Solutions

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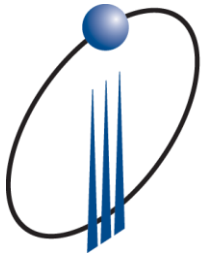

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Solution Overview

- Design Phase Planning
- What to consider when you have a problem
- Redesign discussion
- Interposers
- Using equivalents
- Brokers
- **Best Practice Overview**

First Thing First – Obsolescence and Hard-To Find Supply Chain

Think Long Term Supply Chain at Parts Selection / Initial Design Phase

- Integra sees
  - Parts selected at initial design already on last time buy
  - System and program life plus repairs and maintenance life is not always a consideration at parts selection

Think Life Cycle / Supply Chain Sustainment at Parts Selection / Initial Design Phase

- Integra sees
  - Sole source suppliers for many of the parts – Not preferred
  - Second or third tier suppliers with no track record of longevity or sustained Quality are selected – Not Optimal
- Generational change of product is directly related to obsolescence

Various Supply Chain Solutions

- **US Based Manufacturing With Long Term Manufacturing, Kitting and Storage**
  - Manufacture from Die Bank / Re-Engineering
  - ICs Assembled and Tested in USA

- **Equivalent Commercial / Automotive / Industrial Parts Instead of Mil Grade or Space Grade Parts**
  - Upscreen or use as is if risk can be mitigated

- **After Market Equivalent Product Usage on the Rise – Possible Solution**
  - Manufacture from Die Bank / Re-Engineering

- **Broker Purchase**
  - Only a Few Good Ones – Workable Solution!

- **Costly / Risky Solutions**
  - Board Re-Designs by OEM Are Increasing
    - Replacement of Obsolete Products with Equivalent Currently Offered Products
  - Board Interposers for Equivalent Product in Different Form Factor (least costly)
    - Requires Extensive On-Board Functionality Verification
  - Risky Re-work Process Are Being Introduced Without Checking Long Term Reliability Considerations

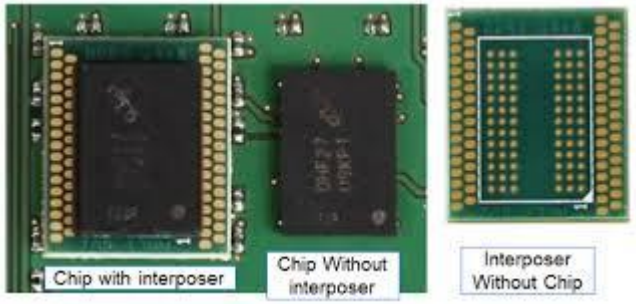
Redesign (subsystem)

- **Redesign**
  - Redesign of an electronic subsystem due to obsolescence
  - Can be benefits of additional capabilities not available with original design
    - B-52 Example - In July 2013, the Air Force began a fleet-wide technological upgrade of its B-52 bombers called Combat Network Communications Technology (CONECT) to modernize electronics, communications technology, computing, and avionics on the flight deck.
  - **Typically, when redesign occurs because of obsolescence – the issue could be merely a very high cost without equivalent benefit**
  - Prior Planning can eliminate Redesign for Obsolescence

- **Redesign Issues**
  - Design development costs are only the initial cost
  - Design complexity since often original component functions may not exist
  - Documentation inadequacies
  - Source code may be lost
  - Original designers have moved on
  - Conversion of older hardware difficult since Vendors have dropped application support
  - Software compatibility concerns (new hardware incompatibilities)
  - Will likely demand new system qualifications and approvals of the users
  - May require new manufacturing methods or processes
  - Repair maintenance training documentation update

Board Re-Designs & Board Interposers

- **Board Re-Designs and Interposers**
  - Replacement of obsolete products with equivalent currently offered products
  - Board interposers for equivalent product in different form factor. Can be least costly when done by original OEM



- **Board Re-Designs and Interposer Issues**
  - Requires extensive on-board functionality verification
  - Most easily done by original OEM when complete documentation exists
  - Will likely demand new system qualifications and approvals of the users
  - Repair maintenance training documentation update

Usage of Commercial / Automotive / Industrial Equivalent Parts

Mil Spec Part Not Available But The Commercial/Industrial/ Automotive Equivalent May Be Available

Advantages

- Most commercial die are identical to the military version
- Up Screening has been in use for >30 years
- Fresh product with minimal storage and handling risk
- Significantly lower unit cost
- Likely can source from a robust quality vendor
- Plastic is generally very reliable
- Vendor may have comprehensive qualification records
- If obsolete; brokers should have greater availability of commercial parts
- High reliability source

Usage of Commercial / Automotive / Industrial Equivalent Parts

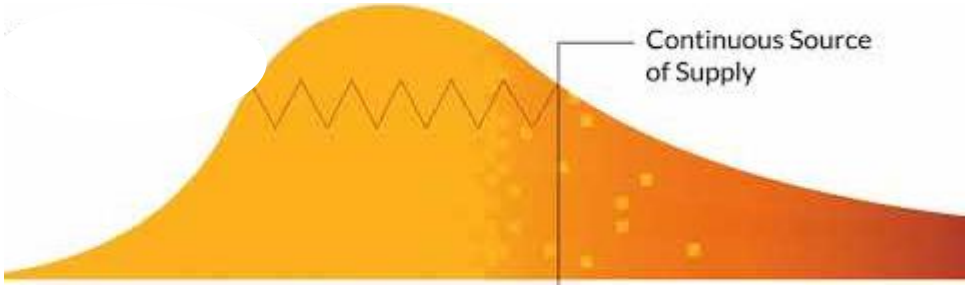
Mil Spec Part Not Available But The Commercial/Industrial/ Automotive Equivalent May Be Available

Dis-Advantages

- Product does not conform to the original mil spec
  - Added screening required – Could be costly
- Likely Pb free (Pb conversion needed)
- Device revisions since original mil product
  - Higher speed possibly noisier
  - May have less temperature tolerance
  - Software/hardware incompatibility
  - Radiation Hardness unknown
- Plastic vs Ceramic
  - Reliability Concern to be considered
- Different footprint (Industry transition to surface mount)
  - DIP to SOIC
  - PGA to QFP/QFN/BGA
  - Metal Can to SOT

Aftermarket Equivalent Product Usage on the Rise

- **Aftermarket Equivalent (Rochester Model)**
  - Manufacture from die bank
  - Re-Engineering
  - Companies specializing in taking over production of obsolete products

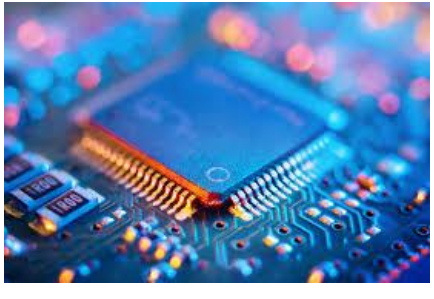


- **Aftermarket Keys**
  - Buy from a company who owns the design
  - Buy from a company that has the documentation
  - Buy from a company that has stored the devices correctly

Broker Buys

- **Broker Buys**
  - **Broker purchase, the most common and probably lowest cost solution**
    - Original parts often exist on the secondary market
  - Availability of “quality” parts can be very limited
  - All units should be inspected, electrically & mechanically tested
    - Use industry counterfeit inspection methods
    - Full parametric functional test at temps for critical applications
    - Plastic – CSAM & DPA analysis
    - Hermetic - Leak testing, XRAY and possibly PIND
    - Consider a qualification sample test

- **Broker Buy Considerations**
  - **Unless bought from reputable Independent distributors or Franchised Broker:**
    - Buyer beware – A very few elite Independent distributors
    - Counterfeit devices prevalent
  - Only remaining devices may be board pulls “salvaged units”
  - Diminished reliability
    - Concern with parts storage
    - Handling risk (Temperature stress, ESD and contamination)
    - Solderability issues



Best Practices for Obsolescence Management

- **Plan ! Plan! Plan ! Planning is Key**
- Most companies fail to plan and budget for obsolescence and its mitigation
  - Budget for
    - Planning
    - Re-design
    - Buying inventory and piece part cost
    - Storage cost
    - Qual cost
  - Personnel to plan and manage
  - Typically obsolescence planning an after-thought
  - Costs best justified if several components are at mitigated at same time

Best Practices for Hard-To-Find and Obsolescence Management

- **OEMs Need a Formal Supply Chain Management Plan / Org**
  - Is the part at or near EOL or is the demand increasing
  - Are the manufacturers having long lead times
  - What is the anticipated EOL of the Part – Predictive model based on manufacturer's history and technology generation change
  - What is the Life of the Program and life of the BOM parts
    - New system builds
    - Replacement and maintenance requirements
  - Rate the various potential reasons on why supply chain issues could occur and its mitigation plans (Technology, FIT, Legal, Form, ROI)

Best Practices for Obsolescence Management

- **OEMs Need a Formal Supply Chain Management Plan (continued)**
  - Understand the various supply chain choices
    - Long term inventory buy
    - Dedicated line continued manufacturing for obsolete or high demand product
    - After market manufacturing (not same as dedicated line continued manufacturing)
    - Broker buys
    - Etc.
  - Long term inventory management
    - Needs a storage plan
    - Needs a re-lifing plan (typically after every 5 years)
      - Retest (Electrical; life test etc.)
      - Solderability

Best Practices for Obsolescence Management

- **Have a Good Parts Management Database System. The Ideal System Should Have:**
  - Supply chain information (parts availability sources)
  - Applicable to most EEE parts (Ics, Connectors, Magnetics etc)
  - EOL and PCNs readily available for the part
  - Import / Export compliance regulations
  - Alternate parts information
  - Parts datasheets
  - Ability to process multiple line item BOMS
  - Leadtime analysis capability
  - Any alerts (GIDEP, ERAI etc.)

Best Practices for Obsolescence Management

- **Consider Replacement Options/Choices**
  - Cost trade-offs / Look at all costs and consider long-term tradeoffs
  - In-house engineering / Subcontracted / Full turn-key
- **Electrical Test: Key Element in All of the Obsolescent Solutions**
  - Careful selection of test requirements and labs
- **Qualification is a Key Consideration for High Reliability Applications**
  - Supplier data may not be complete or robust enough for demanding applications
  - Customize qualification plans around the die and package risks
- **Careful Consideration Should be Given to the Package Technology**
  - Plastic acceptability vs Ceramic
  - Concern for Ultra thin, chip scale and BGA packages
  - Avoidance of Pb-free “Green packages”
- **Evaluate and Monitor Your Suppliers**
  - Technical oversight is a necessity
  - Formal supplier relation (example: Master Supplier Agreement)

Best Practices – Supply Chain

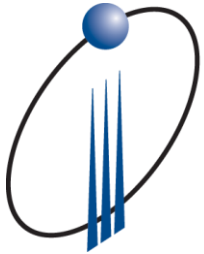
1. Buy parts from the original manufacturer or authorized distributor if possible.
2. Keep an eye on parts shortages and growing leadtimes as they become known
3. Buy parts from authorized after market manufacturers (Traditionally companies like Rochester and Lansdale, but increasingly companies like Avnet and Arrow).
4. Buy parts from known sources with original paperwork traceable to the original manufacturer (another OEM that bought parts from a franchised source and has the original paperwork).
5. Do last time buys when parts become obsolete (can be expensive and hard to estimate exactly how many will be needed).
6. Qualify alternative suppliers which may not yet be obsolete (when market demand decreases usually all suppliers get out of the market).
7. Use FPGA's/ASICs to emulate obsolete devices (expensive, requires board re-layout at a minimum).
8. Buy parts from a reputable non-franchised broker (risk based electrical testing and evaluation is necessary).
9. Buy parts from a questionable broker (must do full electrical test and possibly qualification).

THANK YOU

Contact information:

***sultan.lilani@integra-tech.com* (510.830.9216)**

***matt.bergeron@integra-tech.com* (503.510.1500)**



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