Electronic Part Obsolescence Forecasting

Pro-Active Approaches to Part Obsolescence Management

Understanding that electronic part obsolescence is going to be a significant contributor to system sustainment costs, what actions can be taken during the initial system design to minimize the impact of part obsolescence?

While reactive obsolescence mitigation approaches can provide 3:1 paybacks, pro-active part obsolescence planning holds the promise for 20:1 or 100:1 paybacks*.

- Judiciously choose parts (part selection)
- Forecast part life cycles
- Life cycle planning

Careful Part Selection

- Does the part manufacturer recommend usage in new designs?
- Is the manufacturer willing to support the part for the long term?
- Is the part technology likely to become obsolete (such as through-hole versus surface mount)?
- Is the part single-sourced, or is there more than one supplier?
- Are upgrades/substitutes available?
- Can the part be emulated?
- Is the part "modular" in nature (e.g., ASIC)?
- Are the aftermarket suppliers likely to support this part?
- Is the part to be placed on (economically) discardable sub-assemblies?
- Has the design been partitioned to simplify solutions to expected part obsolescence problems?
- Does the design consider plans for future enhancements/upgrades?

Forecasting Part Obsolescence

Objective: Track and archive obsolete parts and predict when existing parts will become obsolete.

Approaches (tools and databases):
- i2 (Aspect, TACTech)
  - TACTech
  - TACTRAC Health Model
  - Lifecycle Management (LCM)
- CALCE (University of Maryland)
- OPT (SHAI)
- MTI
- Total Parts Plus
- +many other commercial and government database and alert services (GIDEP, IHS, …)
**i2/Aspect/TACTech Tools**

**TACTech:**
- Traditionally more focused on providing discontinuance information on parts already obsolete rather than on lifecycle forecasting for existing parts
- Forecasts parts-specific obsolescence risk index
- Based on TACTech database
- May not be kept up to date with new parts in future (phasing out)

**TACTRAC Health Model:**
- Forecasts obsolescence risk associated with an entire BOM
- Understands physical hierarchy of system, i.e., can see common parts in different parts of the system
- Provides alternative part assessment
- Post-processing (plots, reports, etc.) that TACTech service does not provide
- Based on TACTech database, but can be linked with Aspect database

**Lifecycle Management (LCM):**
- Lifecycle management shell around TACTRAC
- Lifecycle optimizer – recommend alternates for obsolete parts
- Workflow process manager
- Integrated with Aspect electronic parts database

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**TACTech Obsolescence Forecasting**

TACTech life cycle forecasting uses an approach in which the part life cycle stage is determined by averaging unquantifiable technological and market attributes.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>1: Emerging</th>
<th>2: Growth</th>
<th>3: Mature</th>
<th>4: Decline</th>
<th>5: Phase Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>&lt;= 10 ns 200-500 MHz</td>
<td>11 to 24 ns 133-200 MHz</td>
<td>25 to 34 ns 60-133 MHz</td>
<td>35 to 45 ns 16-60 MHz</td>
<td>55 ns or slower &lt;16 MHz</td>
</tr>
<tr>
<td>Process</td>
<td>BiCMOS</td>
<td>DMOS</td>
<td>CMOS</td>
<td>Bipolar</td>
<td>PMOS NMOS</td>
</tr>
<tr>
<td>Sourcing depth</td>
<td>Introduction of new technology, limited sourcing</td>
<td>Secondary sourcing</td>
<td>Mature sourcing, production peaking</td>
<td>Production declines, discontinuance begins</td>
<td>Not suitable for design, phase out in progress</td>
</tr>
<tr>
<td>Usage</td>
<td>Design in</td>
<td>Increasing</td>
<td>Leveling off</td>
<td>Declining</td>
<td>Phase out</td>
</tr>
<tr>
<td>Substrate</td>
<td>GaAs</td>
<td>Silicon</td>
<td>Germanium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complexity</td>
<td>ULSI</td>
<td>VLSI (100,000+)</td>
<td>LSI (10,000+)</td>
<td>MSI (1,000+)</td>
<td>SSI (100+)</td>
</tr>
</tbody>
</table>

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Very Expensive
TACTech Obsolescence Prediction

- Fundamentally TACTech outputs
  - Data in the form of a number (index) that represents obsolescence rating of the component
  - The index can vary from 1 through 5
  - Data is available only for active components; passive components are assumed to be available at all times in some form
  - TACTRAC post-processes the raw data above and allows it to be used at board and systems levels
- What does the index mean?
  - An index value of 1 means being in the beginning stages of life of the component and 5 being in the ending stages of the life of the component
  - The life span of the component is an average mean lifetime of the component category it belongs to, e.g., microprocessors, transistors, diodes etc.

TACTech: Disadvantages

The disadvantages of the TACTech approach are that it:

- does not capture market trends accurately, instead relies on unquantifiable attributes such as technology complexity, usage, and sourcing depth.
- uses the number of sources (for procurement) in predictions, which may give false or inaccurate results.
- does not forecast years to obsolescence of a device/technology group, instead gives an overall life cycle stage for the part number. For example, a manufacturer discontinuing a part does not imply that its device/technology group is obsolete.
- makes the erroneous assumption that all microcircuits follow the same life cycle curve, e.g., in reality, 16-bit RISC microcontrollers, 4-bit CISC microcontrollers, and 16M DRAMs all have different life cycle profiles.
TACTech Business Model

- Traditionally, TACTech’s success was based on an extensive network of human contacts at IC manufacturers and distributors
- Potential competitors could not build or maintain a network to complete with TACTech
- With IC manufactures adopting of the web as the preferred delivery mechanism for PCNs and other data associated with electronic parts, the value of TACTech’s human network is decreasing
- Other web-based services (e.g., PCNAalert.com, Total Parts Plus) are catching up quickly

Mapping TACTech Data to Years-to-Obsolescence

- TACTech is a popular approach to obtaining obsolescence data for electronic components, but the obsolescence index data must be mapped to obsolescence dates and uncertainties for use in life cycle cost modeling.

\[
\text{Obsolescence date} = B + L \left(1 - \frac{(i-1)}{4}\right)
\]

where,

- \(B\) = Base year
- \(L\) = Life span of the component
- \(i\) = TACTech obsolescence index
Electronic Component Years-to-Obsolescence Prediction

- Curve-fit sales data of primary attribute (for example, DRAM memory size)
- Plot curve fit characteristics vs. primary attributes to form trend eq.
- Evaluate years to obsolescence from trend equations
- Curve-fit sales data of secondary attribute (for example, package style)
- Evaluate years to obsolescence from curve-fits of secondary attribute
- Modify life cycle stage and years to obsolescence of primary attribute by that of secondary attribute if required


Trend Equations for DRAMs

CALCE Electronic Products and Systems Center University of Maryland
Obsolescence/Technology Insertion
Secondary Attribute Example
(Bias Voltage Trends)

Life Cycle Phases: Exceptions

- False starts: stall in part growth because of
  - introduction of a superior competing product
  - identification of a problem associated with a product
  - failure to reach critical mass that allows economies of scale
  - failed emergence of a compelling application for the product
  - Example: GaAs, a niche technology might soon become obsolete and be replaced by CMOS, which requires less power and is cheaper to manufacture.

- Niche: Products serve niche markets only

- Revitalization: Product revitalization by defining new market segments and/or product use
ASICs differ from off-the-shelf parts in several ways, however, the critical differentiator from an obsolescence viewpoint is that for ASICs the customer has some level of ownership over the design information associated with the part.

For an ASIC, the sales curve could represent any one of the following (or combinations of the following):

- Ability or willingness to fabricate the part.
- Ability or willingness to design the part. Loss of ability to design the part may be due to loss of the required design tool support, loss of human expertise, unwillingness to commit design expertise (too busy designing for newer technologies), or lack of availability of the appropriate intellectual property (IP) – IP obsolescence.
- Lapsing of legal rights to use the necessary IP. The ASIC supplier has the technical capability but no longer has the necessary legal rights to design or fabricate the part.
Using Custom ASICs to Avoid Obsolescence Problems?

Custom ASICs have been used by many companies, in an attempt to mitigate hardware obsolescence problems:

Advantages:
- You have some ownership over the IC design (IP, mask set, etc.), and therefore, have some level of control over its obsolescence, theoretically, a custom ASIC never needs to become obsolete
- Very effective way to avoid software obsolescence

Disadvantages:
- Owning the mask set doesn’t automatically mean that you can find someone to fabricate the chip for you. You must keep up with:
  - Fabricator wafer size changes
  - Fabricator process changes
- Moving from one ASIC vendor to another may require re-qualification
- You are not immune to technology obsolescence
- Once you are on the ASIC highway, its hard to get off

Using Programmable Gate Arrays to Avoid Obsolescence Problems?

Programmable Gate Arrays (PGAs), for some applications, may provide ASIC advantages without all the custom ASIC disadvantages:

Advantages:
- You have some ownership over the custom programming of the gate array
- You need not worry as much about fabricator wafer size and process changes

Disadvantages:
- Programmable gate arrays may not be able fulfill your application needs or performance requirements
- You are still not immune to technology obsolescence
- Once you are on the ASIC highway, its hard to get off (but its easier to get off PGAs than to get off custom ASICs)
Obsolescence Prediction Tool (SHAI)

- Predicts when electronic components are likely to become outmoded and their production discontinued.
- Obsolescence of a part is predicted by first querying a parts database to identify key attributes of the part or family of parts, such as its device technology, capacity, and type of packaging. These attributes are then used to query a technology trends forecast database to retrieve generic obsolescence predictors of the part or part family, based on expert opinions. These generic predictors are then fed into a prediction algorithm to derive an obsolescence prediction classification.
- The predictor’s ability is derived from the use of a range of artificial intelligence techniques including case-based reasoning, object-oriented programming, and knowledge engineering.
- It will operate in either an Internet environment via a web-based client server architecture, or in a stand alone environment on a single user’s desktop computer.
- The technology used in this project also be used for any non-electronic components subject to discontinuance due to rapid technical change.

(http://www.shai.com)

MTI Obsolescence Forecasting

- Manufacturing Technology Incorporated (MTI) provides obsolescence prediction information to customers.
- MTI uses proprietary market (α) and technology (β) factors to predict demise of families and technology/market groups (devices with like market and technology factors).
- The proprietary (α, β) factors are pre-determined from “industry knowledge”.
- Using (α, β) factors, MTI calculates a "safe" usage window for a device family.
- The MTI algorithm does not use life cycle curves, and hence is unable to determine life cycle stage for the technology/market family.

(http://www.mtifwb.com/static/obsolescence.shtml)
**Total Parts Plus**

- Provides PCN and product discontinuance tracking and notification
- Substitute part information
- Aftermarket supplier information
- Die manufacturer information
- Projects production status of your part, projected availability in years, and End of Life (EOL) status

(http://www.totalpartsplus.com/products.htm)

**Databases and Alert Services**

There are a growing number of companies and organizations providing databases and databases connected to alert services that archive information on parts that have been discontinued. Examples include:

- PCNAalert.com (Cogent) – delivers manufacturer-specific PCN and PDN information via email
- GIDEP (Government-Industry Data Exchange Program) – government-wide central system for sharing fact-based technical information (US and Canada)
- COMET (Collaborative Obsolescence Management and Evaluation Tool) – provides a hierarchical summary of current obsolescence or DMS status of electronic systems
- Arrow Risk Manager (www.arrow.com)
- Total Parts Plus (http://www.totalpartsplus.com/products.htm)
Data Sources: Market Research Organizations

- Instat, www.instat.com
- Dataquest, www.dataquest.com
- Semico, www.semico.com
- IC Insights, www.icinsights.com
- Integrated Circuit Engineering Corporation (ICE), www.ice-corp.com
- World Semiconductor Trade Society (WSTS)
- Electronic Trend Publications

A Comment on Obsolescence Forecasting

- In the kinetic theory of gases, each atom or molecule in a gas moves randomly so that the position or velocity of any one of them cannot be known. Nevertheless, using statistics, the rules governing their overall behavior can be worked out with great precision.

- The forecasted window of obsolescence for an individual part in a specific application is not an accurate predictive exercise on which it makes sense to consider confidence levels or risks. The value of the obsolescence forecast is in the long-term aggregate picture.

- In other words, forecasting the obsolescence of many parts in many products and using those forecasts to adjust bills of materials, and optimize design and sustainment is advantageous. The value of a single obsolescence forecast on a single product is hit-or-miss and is most likely much smaller than the aggregate value of forecasting for every product.

- Individual part obsolescence forecasts are noise, value is in forecasting for many parts over many products.