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Remanufacturing thwarts obsolescence in mission-critical systems

In the fight against obsolescence in mission-critical systems, opting to remanufacture obsolete systems can be a viable remedy. Hence, start-up and materials costs, hardware design, and program planning are key considerations.

By Arlin Niernberger, GD California, Inc., May 2008

The resolution of obsolescence for mission-critical electronics systems is of utmost importance. Obsolescence issues affect almost every electronics system that is maintained long-term. Arlin describes specific issues and suggests solutions to sustain those systems, focusing on the option to remanufacture obsolete systems. Key considerations include start-up and material costs, along with hardware design and program planning.

Organizations that provide support for obsolescent systems face many challenges that "normal" manufacturing operations do not. Diminishing material resources is perhaps the most critical factor to be considered.

Most aging electronics systems function at a totally acceptable level as designed; yet as the system ages, the Mean Time Between Failure (MTBF) becomes unacceptable, thus jeopardizing the mission itself.

A 2006 GEIA study indicated that throughout the next decade, the average age of military air fleets will exceed 20 years (http://mae.pennnet.com/articles/article_display.cfm?article_id=276029). This indicates that MTBF issues and solutions to reduce those problems will become of greater concern over the next 10 years.

Most end users face the alternatives for support listed in Table 1. No single one of these options is a solution for all situations, but all of these options are usually considered when extending the service life of aging electronics systems. Our discussion will focus on the third option listed in Table 1, remanufacturing obsolete systems.

Alternatives for sustaining obsolescent systems	
System replacement	As new hardware technology becomes available, it is common to find that the electronics on one redesigned board can replace the electronics in a completely obsolete system. This option may be practical when there are no software changes to be required. However, the cost for design resources, time to implementation, and system requalification are important considerations and may require significant resources.
Limited redesign	Replace only those portions of the system that have become obsolete: The latest developments in software-defined hardware have allowed for module (or board) replacement at an economical cost. However, as cost effective and time efficient as this alternative may seem, requalification would still be required, which may induce considerable cost.
Remanufacturing	Remanufacturing the unit using the same components as the original design: This includes remanufacturing components where necessary. In many cases, this is the best solution for the customer. Remanufacturing a product requires no requalification, software will not be affected, and resources for redesign would not be required.

Table 1

What are the pros and cons of this method, and how do we best implement it? More importantly, how can we make remanufacturing a cost-effective alternative in most cases? How should we plan in advance?

Benefits of remanufacturing

Most supply chain managers, when faced with the dilemma of whether to repair or replace obsolete systems, can appreciate the advantages provided by remanufacturing:

- Existing system software can be used. No software changes are required to keep the system operating as before. No software development is required or programming time necessary.
- Hardware design resources are not required for remanufacturing. Some components may be required to be re-specified. However, that function is usually supported by sustaining rather than design engineering.
- There is no need to requalify the system. In many situations where hardware or software changes are made, the system has to be requalified. Often the original qualification processes must be used. This can be costly as well as time consuming.

Remanufacturing challenges

On the other hand, there can be disadvantages to the remanufacturing approach, such as IP issues and obsolete/counterfeit components.

Intellectual Property

Intellectual Property (IP) is the information necessary to manufacture or test the board or system. Pieces of the IP may be missing, incomplete, or incorrect.

An example of this would be where a bill of materials may be incorrect, or "approved suppliers" are no longer in business. Fabrication drawings may be missing, incomplete, or wrong. Diagnostics and test fixtures required to verify the build and to validate final test functions may no longer be available.

Obsolete or counterfeit components

As systems age, the pool of available components diminishes. Electronic components have on the average a four- to seven-year manufacturing life as compared to a life cycle of 20 or more years for mission-critical systems. As components become in short supply, the demand for components attracts counterfeiters such that few reliable sources remain available. Dealing with unreliable component sources becomes a huge burden in time and money to many companies.

This is where legacy companies such as GD California (GDCA) are a critical asset in providing ongoing support of obsolescent circuit card assemblies and systems.

Weighing the costs

A case for remanufacturing as the most cost-effective alternative is best made by presenting a brief cost analysis. Two primary cost considerations are project startup costs and material costs.

Startup costs

The numbers generally referenced when discussing the startup costs of obsolescence support are the numbers generated by the Defense Micro Electronics Activity (DMEA). The metrics generated by that organization are used by DoD programs to report cost avoidance associated with implementing the best resolution in line with program requirements and cost constraints (www.dmea.osd.mil/docs/cost_metrics_revision1.pdf).

Though the DMEA uses a comprehensive description of issues related to diminishing resources, some legacy companies have expanded cost avoidance to include program preplanning at the design stage, end-of-life buys, and component redesign as important alternatives. Figure 1 lists some DMSMS legacy options available to the end user.

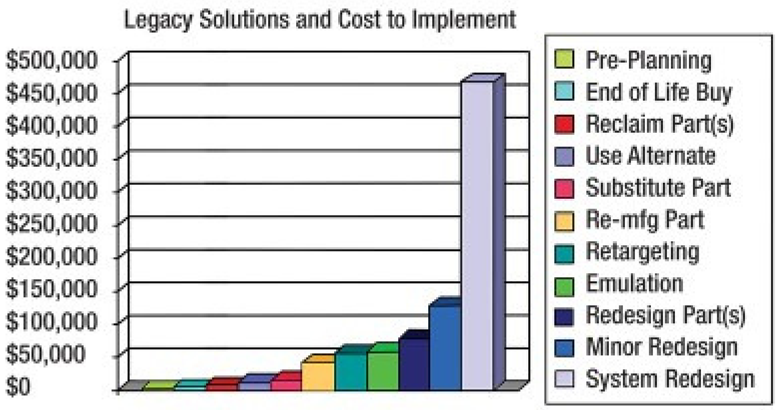

Figure 2

(click image to zoom by 2.0x)

Costs shown on the graph depict actual average program costs relative to specific programs. They may not apply to all vendors' specific projects. However, the costs listed show an accurate cost relationship between the different alternatives and indicate relative costs in performing activities required to sustain a product.

Logistical options (first six listed) are much more cost effective than the engineering alternatives (last five listed). The last choice listed (major system redesign) is the most expensive option and the least appealing to apply in most circumstances.

Material costs

As components become scarce, two situations affect cost: (1) If the components are obsolete now, component prices can be very high; (2) If the components have not been discontinued yet but soon will be, the prices may be quite reasonable.

When a component is obsolete now

Material costs are related to market availability of the components, and that changes rather rapidly and sometimes unpredictably. Creative sourcing is required where components have been obsolete for many years, and many larger organizations have developed dedicated resources to deal with locating obsolete components.

Developing and maintaining this capability in an organization is in itself an operations cost related to materials that cuts into company profitability. A good course of action is to eliminate as much of this type of activity as possible to reduce costs.

When a component is going obsolete soon

To keep your organization from having to conduct heroic buys on an ongoing basis, it is important to monitor component availability and plan program support. Most companies do this to a certain degree. Numerous software tracking packages make obsolescence tracking fairly straightforward. Once a component shows up as going obsolete, a last-time buy can be scheduled.

Because of the cost involved in last-time buys and the unpredictability of end user requirements, this option may not be practical in some cases. Other options can be pursued before material shortages create a critical support issue. The most practical option is to respecify components where a component that is in current production is used in place of the original. Requalification usually consists of lab and systems testing. The use of alternate components at this point also heads off future issues.

Planning ahead

Legacy solutions can be implemented at any stage in a program. The earlier in the program the initiative is taken, the less expensive obsolescence support becomes.

With that assumption in mind, when designing new products, design criteria should include a plan that encompasses hardware and program planning considerations for obsolescence.

Hardware design planning

Several design rules for obsolescence planning at the design stage exist. One is to place designs that are device independent in programmable semiconductor components. This ensures that migration to new devices is a simple process as long as the intellectual property and design environment are preserved.

Applying circuit design that can be sustained easily over a long period of time is another effective hardware remedy. This may be more difficult to implement in a design but may prove more cost effective in the long term. Selection of components in such a design may consist of going "lower tech" rather than using the latest technology.

A design strategy long taken by many system designers is to use COTS electronics in their system designs. Medical, industrial, and government organizations have made this a preferred path where possible. One great advantage in using COTS products is that many COTS products are supported indefinitely under license by GDCA.

Program planning

After a product has been launched, the forward-thinking project manager may consider obsolescence planning long before a product’s components become obsolete. One such process is the AAP.

The AAP is an agreement binding the end user, manufacturer, and a legacy company such as GDCA. It ensures that when the manufacturer stops producing a product, the legacy company will step in to continue manufacturing and repair support over the life of the agreement. This gives the end user uninterrupted product support, an insurance policy against obsolescence.

In cases where there are immediate obsolescence issues, legacy vendors use the PSA agreement. In this instance, they procure and hold end user inventory until required for manufacturing and repair.

In both the AAP and PSA, the end user controls the materials commitment over the remaining project life cycle. If requirements are declining at a diminishing run rate that will become zero in seven years, the end user can lay in enough stock (on the few critical parts required) to last until the projected product life will no longer require support. Should the run rate change, the end user can decide to increase or decrease stock in reserve.

Extinguishing the fires of obsolescence

In general, any organization that has a vested interest in sustaining its equipment long term cannot afford to solve issues that arise in due course by "fighting fires" or waiting until a system goes down to find out repairs cannot be made. Therefore, organizations must act proactively and decisively using cost-effective tools – including preplanning at the design stage and end-of-life programs that ensure availability of components and support – that are readily available to solve obsolescence issues before they arise.

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