SW Test Workshop
Semiconductor Wafer Test Workshop

Managing Test Cell Obsolescence

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Abstract

- With the extreme maturity of semiconductor manufacturing and the end of built-in productivity entitlements, there has been a corresponding loss of momentum in new capital equipment procurement. Production test has always been categorized as a non-value-added process to be minimized. The new economic reality has taken this aversion to test cost to another level. Testers which are 20 to 30 years old must not only be sustained but improved to reduce cycle time and increase measurement capability for new applications. At the same time, capital equipment vendors are working hard to force obsolescence of the installed base.

- This presentation will discuss the legal, operational, supply-chain and performance attributes of obsolescence management for test.

Overview

- Legal Considerations
- Operational Considerations
- Supply-Chain Management
- Performance Entitlement
- Summary

Legal Considerations

- **OEM Sabre Rattling aside, the law supports sustaining practices**
  - Phoenix Technology's clean room technique (1984) and IBM's legal response are described in Russell Moy, "A Case against Software Patents," Santa Clara Computer and High Technology Law Journal 17 (2000):72-73.
    - Confirmed and expanded by 1992 case of Sega v. Accolade, 977 F.2d 1510 (9th Cir. 1992)
    - Permissible Reconstruction
  - US Supreme Court Cases Aro I and Aro II
    - Aro Manufacturing Co. v. Convertible Top Replacement Co., 365 U.S. 336 (1961)
    - Aro Mfg. Co. v. Convertible Top Replacement Co., 377 U.S. 476 (1964)
    - Permissible Repair
  - Sec. 103(f) of the DMCA (17 U.S.C. § 1201 (f)
    - Reverse Engineering and Re-use to facilitate interoperability
    - Permissible Reverse Engineering

Legal Considerations

- **Test System Applications of Fair Use**
  - Permissible Reconstruction
    - Clean room examination and specification of a Test Executive or licensed performance feature and Reconstruction using Virtual Instruments.
  - Permissible Repair
    - Porting instrument control from obsolete OS to current OS via VM or Hardware Emulator
    - Even if copyrighted software is copied; Sega v. Accolade, 977 F.2d 1510 (9th Cir. 1992) and Sony v. Connectix, 203 F.3d 596 (9th Cir. 2000).
  - Permissible Reverse Engineering
    - Determining behavior of tester sub-systems to enable interoperability with factory automation (Application Control, Diagnostics, Calibration, PM)
    - Any and all activity enabling hardware repair of equipment you own

Operational Considerations

- IT Operations are increasing custom security content on internal OS distributions; restricting number and type of supported OS revisions.
- ESH and RoHS standards updates are affecting both the use and repair of installed equipment.
- Downsized OEMs can't keep up with the applications development needs of users.
- OEM supply chains increasingly visible and accommodating to third party repair services and owner-repair activity.
- eBay has increased parts availability options for repair activity.

Operational Considerations

- The old capital equipment business model for test
  - Moore's Law provided built in price/performance gains for test vendor and test customer.
  - The market precipitated performance driven obsolescence replacement for both.
  - Margins were a function of performance aging for both.
  - Applications development burden was on vendors and primarily for new systems.
  - Applications and repair costs were measured as a fraction of depreciation expense.
  - The lowest cost of test was achieved with maximum general purpose capability.
- The new capital equipment business model for test.
  - Moore's Law is dead and price/performance gains come from innovation, only, for both
  - The market responds to wave apps, resists obsolescence and values longer product lifetime
  - Margins are a function of sustained value or fleeting wave app demand
  - Applications development burden is on the customer for the specific tools producing the app
  - Depreciation costs held near zero. Applications and repair costs are highly scrutinized
  - The lowest cost of test is achieved by getting more out of existing equipment with rapid adaptations to address capacity for wave apps

Supply Chain Management

- OEM → Third Party → Enhanced

Interlocks	Coded and Visual	Integrate with Factory Automation
WS & OS	X86, Linux, PCI Cards	Replace with ICF Controller
Switches	Upgrade BW/Iso	New PCB, New Material, Higher Density
ICF & Instr.	Update Instruments	Update Instruments & Communication
PS & PDU	Component Upgrade	Reduced Power Consumption
Docking	Add CDA, Opto, Dcon	Improve Thermal

Internalizing spare part management is assumed for Third Party support phase
PCB Design and Mechanical Engineering resources assumed for Enhanced phase

Supply Chain Management

- OEM → Third Party
  - **Cost** of obsolescence management includes engineering resources to manage more vendors, document procedures, train vendors and qualify the solutions. Must be less than OEM margin.
  - **Environmental** support includes RoHS compliance update on all affected components of the systems.
  - **Technology** inventory means aligning capability to manufacturing roadmap for new materials, devices and packages
  - **Responsiveness** to hardware and software issues is now owned by the customer not the OEM. This cost needs to be factored into sustaining.
  - **Assurance** of supply for production tools implies supplier redundancy
  - **Quality** standards are higher for this activity (incoming QA). MTBF model assumes serial, non-redundant, composite (customer owned now). Real time module performance monitor is standard.

Performance Entitlement

- Test Controller – Typically get >10% TTR migrating from RISC OS to X86 Linux. Also improves debug and IDE tools. Motherboard sensor/socket improvements.
- Repair Cost – Change switches, fuses and caps rather than entire PS/PDU modules. Change pins rather than pin cards or interface modules. Net 30%-50%.
- Augment measurement capability with open architecture solutions (PXI, LXI, etc) which are cost competitive, multi-vendor and current. Improve precision and synchronization.

Performance Entitlement

- Open systems allow integration of business-specific, customer-designed test modules at very low cost.
- Commodity switch controllers can be used with custom relay arrays for optimal reconfiguration of resources
- The process facilitates standardization for global organizations.
- Ownership of all performance metrics for the test cell improves, as well as alignment to business and technology needs.

Summary

- Step 1 is to bring all systems with scheduled EOL to the latest OEM revisions under a single customer-specific standard configuration
- Step 2 is to develop third party repair of the highest failure rate modules and engineer life extensions as part of your internal stock plan
- Step 3 is to prepare for PCB wear out phase by replacing OEM instrumentation with open solution under legacy OEM function calls.