Improving how we Develop and Implement Standards

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  - Cycle time from Guidelines to Working Implementations
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- **Next Steps**
  - Priority is fixing this industry situation

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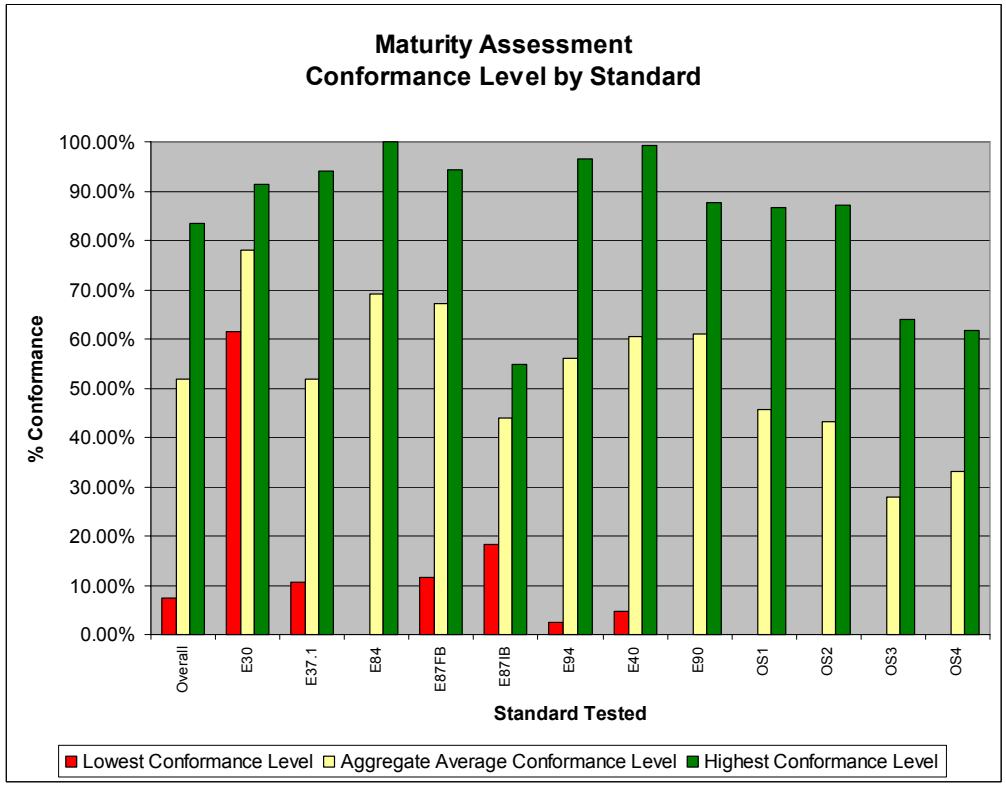
300mm Aggregate Results

- Conformance Level is the combination of Coverage and Test Result %
- The Conformance Level measures the extent to which the tool met the requirements
- The average results can be considered a snapshot of the state of the industry
- Test Coverage had a more significant impact on the Conformance Level than Test Result %



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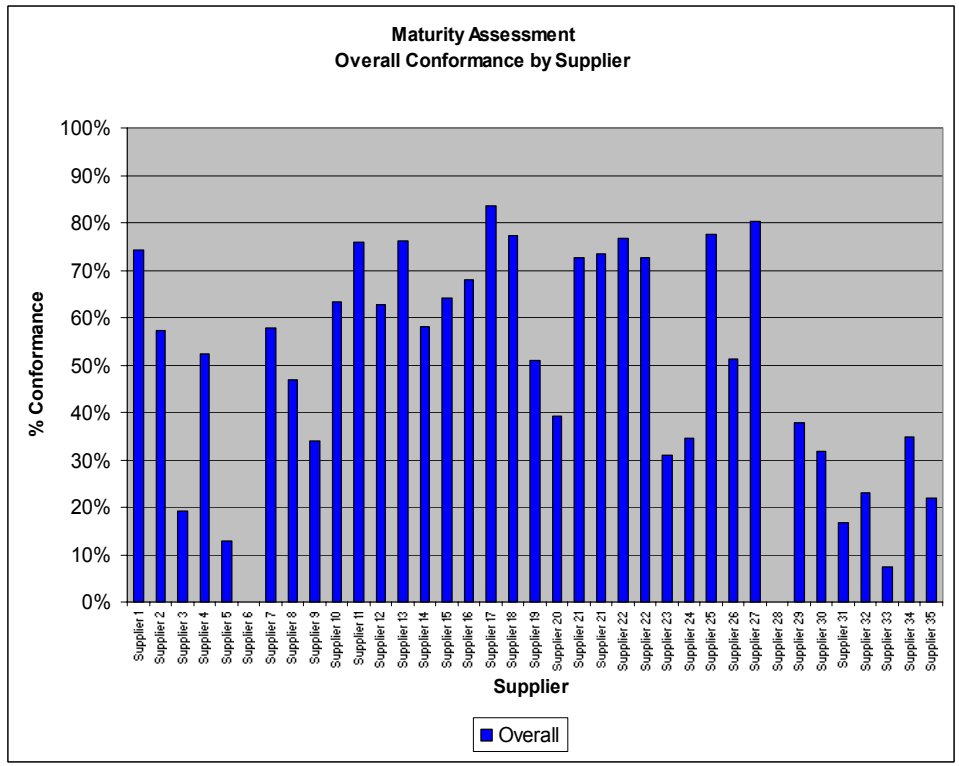
Overall Conformance Levels

This chart shows the Overall Conformance Level by tool for our most recent tests in 2002

Approximately half of these tools have Conformance Levels well below 50%

Tools with Conformance Levels >85% are more easily integrated into fab environments

Meeting these fundamental requirements, even low volume operations, is no guarantee of good performance in High Volume Production usage



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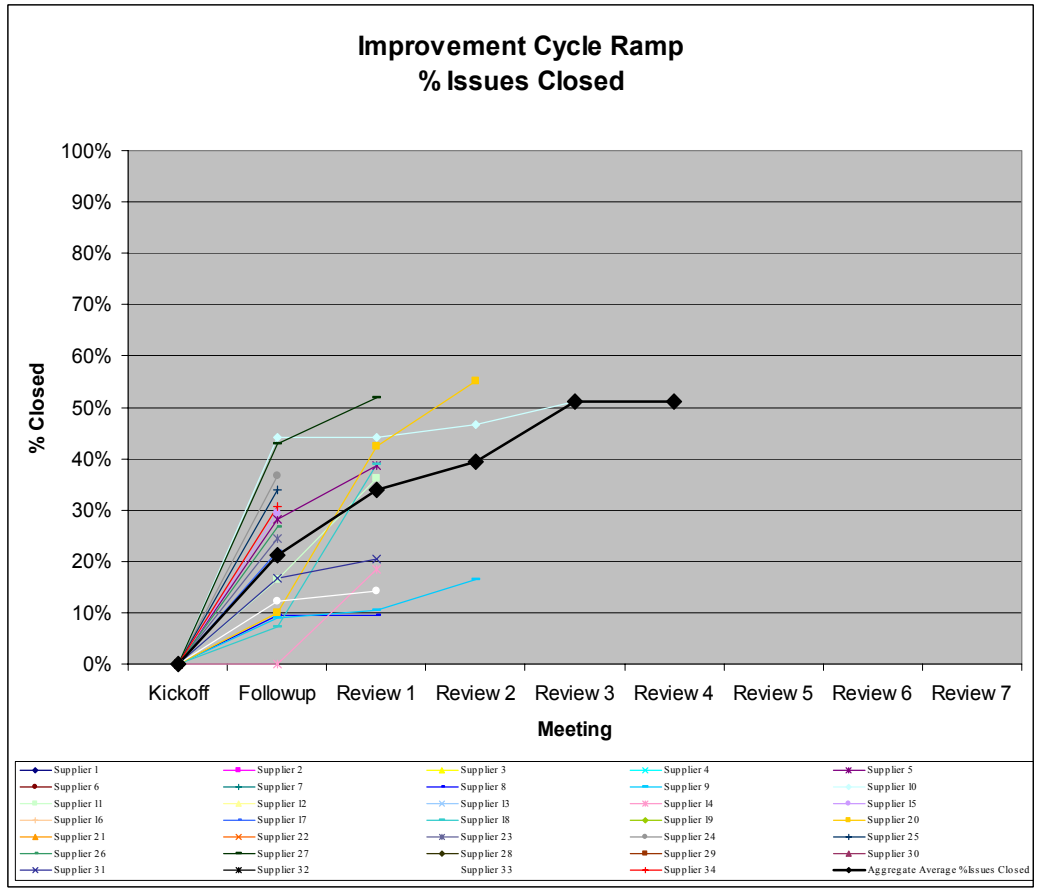
Improvement Cycle Results

- **Issue Closure Rate**
  - **represents the rate of correction or growth of the software**
- **Approximately 25% of**
  - **issues identified were easily corrected in under 1 month (low hanging fruit)**
- **The focus in the**
  - **Improvement Cycle is on issues that are most important to ISMT Member Company end users**



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Summary of 300 mm Experience

- Equipment and software reliability is low
- Standards not implemented, incomplete implementations, incorrect implementations, or delivered much later than initial need
- Documentation is incomplete, incorrect, or out of date
- Revision/release control is missing or poor
- Material/Data mismatch or other data inconsistencies
- Network connection issues, e.g., domain, setup, …
- Error and Exception Handling are addressed inconsistently and ad hoc
- Frequent resetting, initialization, and rebooting of the equipment is required on some equipment
- Field support lacks knowledge, training, and tools for supporting the Factory Automation software

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300mm Lessons Learned

- Many suppliers did not believe that the 300 mm requirements were real, and development did not begin until after orders were placed, this is too late
- The expertise and understanding required to implement the standards did not exist in the supplier engineering ranks. This learning curve caused a significant delay
- Early development and implementation activities, especially the development of in house knowledge and expertise is critical
- The agreed upon requirements and functions in a standard must be interpreted from the perspective of the end user
- Error and exception handling must be considered in standards and implementations
- Initial 300 mm software quality and stability degraded from 200 mm

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300 mm Lessons Learned - continued

- Suppliers that actively participate in the Standards process are more successful in implementation
- Establishing an objective test criteria, like the ISMT Standardized Test enables correct implementations and accelerated maturation
- The quality and stability of the test tools and methods are critical to success
- Partnering or close cooperation with an IC maker or group such as ISMT Test Project significantly improves likelihood of first pass success and accelerates development and delivery

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Impact to Wafer Fabs

- Initial Factory Equipment Interfaces needed to implement work arounds to overcome equipment communications shortcomings
- Factory Equipment Interfaces were developed multiple times as specified standards were delivered
- In order to get correct information about equipment capabilities, direct communications with suppliers' development teams was required taking up valuable time for suppliers and IC Makers
- Many times supplier developers were required on site at the wafer fab to get initial connectivity established
- Error and Exception Handling almost always requires manual intervention and many times equipment has to be restarted to clear problem
- Fully automated material delivery to equipment was delayed
- Equipment integration schedule and cost were negatively impacted
- Factory ramp took and continues to take much longer than planned and requires more resources to accomplish

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Implementation Experience Conclusion

The development and implementation of the 300mm standards was difficult and was late in meeting the requirements of the initial 300mm factories. The impact of these delays and functional shortcomings is staggering in time, cost, and missed opportunity. These issues are being addressed, but the problems continue and will have greater impact as IC Makers work to ramp into High Volume Manufacturing (HVM). The equipment is not providing the functionality required and not achieving the OEE needed in order for the IC Makers to meet their business requirements. We must find a way to work together to improve the process, so we can all be successful.

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Improvement Opportunities

- **The following foils represent the results of initial discussions from ISMT member companies**
  - **Allan Chen-tsmc, Blaine Crandell-TI, Peter Cross-Intel, Karl Gartland-IBM, James Martin-Intel, Jackie Ferrell-ISMT, Lance Rist-ISMT, Harvey Wohlwend-ISMT**
  - **Initial draft presentations given at LaJolla standards meetings**
- **Historical perspective (what worked and what didn't)**
- **Improvement opportunities (what we can do better or differently going forward)**
  - Broader industry ownership in addressing issues
- **Stimulate discussion to identify:**
  - Improvement opportunities that will provide the most benefit
  - Which improvements are supported and implementable as part of the standards development process

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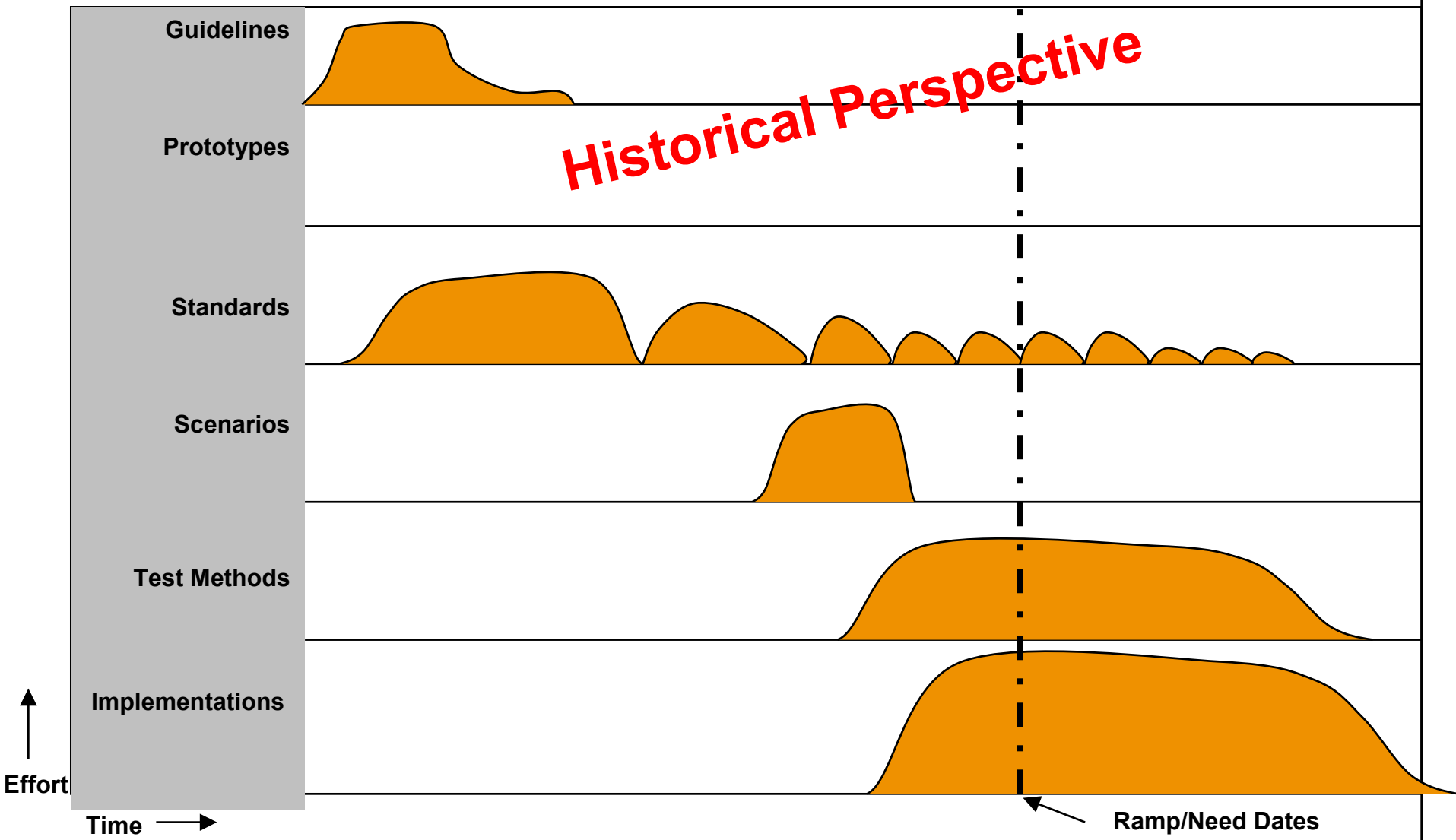
From Guidelines to Implementation



- Lack of early feedback pushes learning, cost, and quality out into implementation, closer to or past ramp dates

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Historical Perspective

IC Maker Guidance	ISMT and Selete/JEITA Joint Guidance ➢ **Guidelines, Guidebooks, Scenarios, Flow Charts, Use Cases** ➢ **Not updated and maintained over time** STEPs – standards education Workshops ➢ **IC Maker roadmap and requirements communicated, started Nov. 1999** ➢ **Useful but suppliers may not have believed the requirements**
Scenarios and Use Cases	➢ **Some scenarios in Standards and Auxiliary Information** ➢ **Limited to typical case, best case, base functionality**
Standards	Many ballot cycles ➢ **Learnings from implementation and operation required** Standards quality ➢ **Complex, open to interpretation, difficult to derive implementation and test requirements** ➢ **Some compliance checklists in standards** Suppliers participation ➢ **More success implementing** Industry usage and guidance ➢ **Outside of SEMI standards development**

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Historical Perspective

Test Methods and Test Tools	• Tests, test methods, and test tools ➢ **Developed after standards were passed** ➢ **Test cases developed outside of SEMI standards** • ISMT testing ➢ **IC maker input to supplier implementations** ➢ **Helped accelerate and improve implementations** ➢ **Late and resource constrained** ➢ **Tools not available for testing**
Working Implementations	• Implementation Guidance was useful to suppliers • Dialogue with early implementers ➢ **User groups 1:1 with suppliers** ➢ **IC Makers refined and articulated requirements** ➢ **Focused implementation direction** • Implementation and adoption ➢ **Purchase Requisitions catalyzed implementations, that is too late** • Gauged progress on IC makers Roadmap ➢ **Workshops to rollout requirements, learnings, Supplier progress reports** ➢ **Early maturity assessments**

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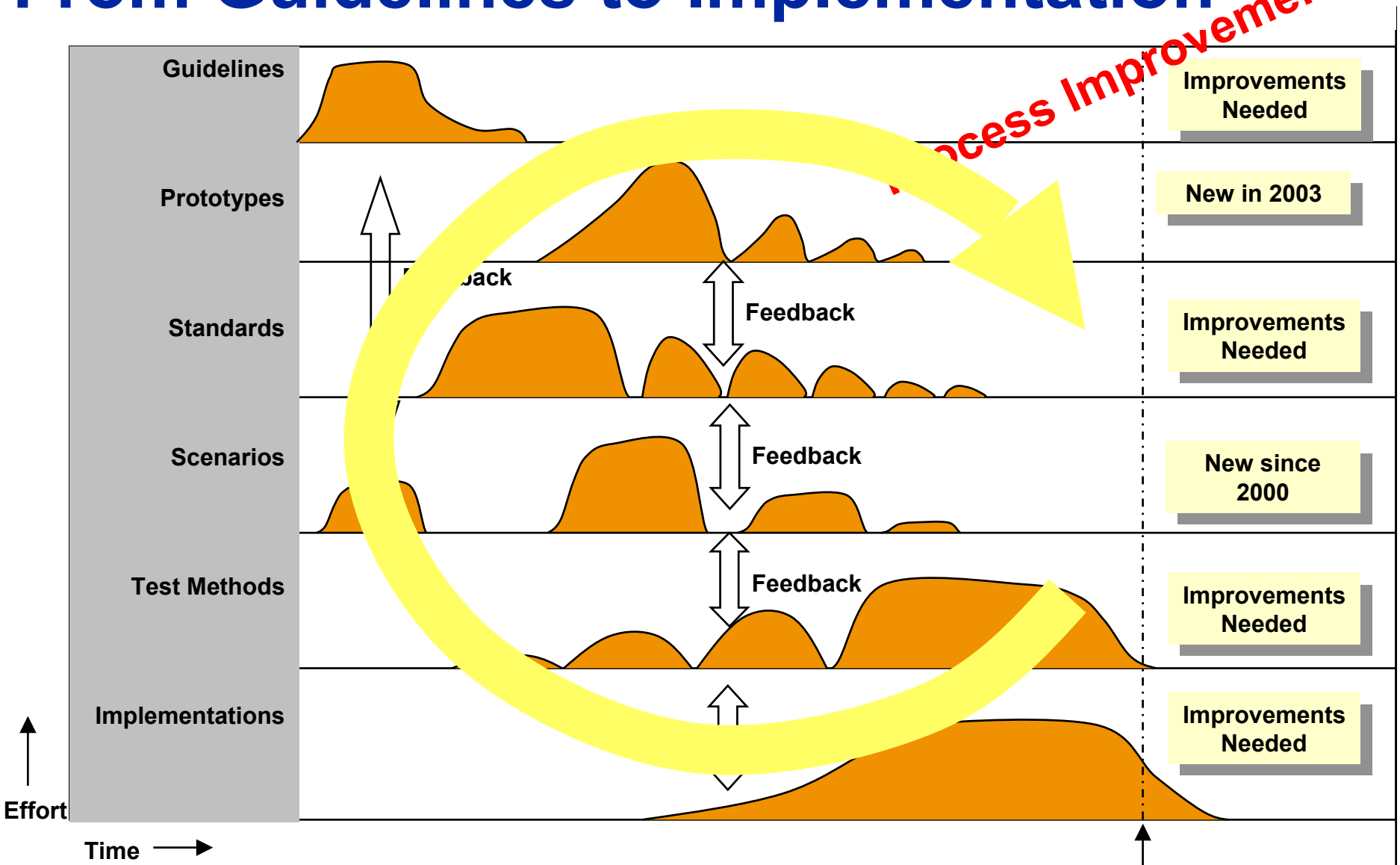
From Guidelines to Implementation



- Smaller scale, earlier engagement can speed learning – quality delivery is ahead of critical [illegible]tes

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INTERNATIONAL SEMATECH

Guidelines and Requirements

Improvement Actions

- Create process for more supplier requirements input
- Consider ramp up through full production manufacturing and exception handling
- Update and maintain the key guidance documents, e.g., operational flow charts
- Expand guidance process to include other 300mm IC Makers
  - ➢Consider User Requirements Documents and User System Requirements Documents for new standards

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Scenarios and Use Cases

Improvement Actions

- Start earlier to support prototypes and standards validation
- Reflect more details of the guidelines requirements
- Update and maintain scenarios and use cases
- Increase emphasis on high volume manufacturing
- Include more exception handling

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Prototypes

Improvement Opportunities

- **Prototype concepts and standards by suppliers (equipment and software)**
  - **Confirm integrity of standard specifications (validate standard)**
  - **Early analysis of feasibility**
  - **Creation of early scenarios**
  - **Prove standards interoperability**
  - **Demonstrate implementability**
  - **Prototype e-Diagnostics, Interface A, …**
  - **Include prototypes as part of standards development process and roadmap**

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Standards

Improvement Actions

- **Design & writing standards for clarity and testability**
  - ➢ **Establish process for test case development**
  - ➢ **Establish traceability of guidelines and tests to standards specifications**
- **Identify BKMs from other standards organizations**
- **Standards creation and balloting process improvements**
  - ➢ **e.g., Better use of "blue ballots," Proposed and Provisional Standards, Auxiliary Information**
  - ➢ **SEMI tools to allow other document forms (e.g., XML), Checklists, Compliance Statements**
- **Expand Standards Roadmap to include IC Maker Roadmap**

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Writing Standards for Clarity and Testability

Readability and clarity	Clear, simple sentences Clear requirements (in bullets or tables) Table of contents and Indexes A requirement should not be open to interpretation A requirement should not be dependent on an optional feature or function
Format	Detailed explanations and additional information in Appendix Cross-link references such as tables and figures in text for easy update Identify dependencies to other documents. Consistency between documents. If necessary, create a document that identifies all inter-dependencies between documents Cross-references need to be checked if a document is withdrawn Place examples in Related Information (not in specification text)
Testable requirements	Describe how fundamental, additional, and optional requirements are to be interpreted Compliance/conformance requirements and templates

(examples)

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Test Methods and Test Tools

Improvement Opportunities

- Develop test requirements and methods as standards are developed
  - Map standards requirements to test requirements and automated test tools
- Equipment and tester software development
  - Follow industry best practices (e.g., IEEE, SEI/CMMI)
  - Revision control, documentation, independent validation of software, etc.
- Industry accepted (accredited) tests for conformance assessments and 3rd party certification
  - Mechanism for IC Maker and supplier validation of tests and use cases

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Working Implementations

Improvement Opportunities

- Implementation Guidance (flowcharts, operational scenarios, test scenarios, and test requirements)
  - Industry repository for long-term availability and maintenance
  - Mechanism for continued user guidance and direction
  - Propose that some neutral organization (e.g., SEMI) should be the owner
- Supplier engagement
  - More supplier involvement with user groups at deep implementation level
  - Scenario development, e.g., exception handling
  - Prototyping of early implementations
- Implementation and adoption
  - Common expectations across IC makers
  - Education on needed standards to IC Maker and supplier negotiating teams
  - Single point of resolution for implementation and interpretation issues (e.g., Improve SIS to form IC Maker consensus response)
  - Multiple independent test s[Back to Agenda]viders and expert resources

Summary

- Focus on reducing cycle time from guidelines to working implementations
- Suppliers engage with IC Makers earlier to accelerate and improve implementations
- Develop and deploy guidelines and processes for developing and writing SEMI standards for testability
- Prototyping and standards validation
- Industry repository for implementation guidance (test requirements, scenarios, use cases)
- Industry resources for accredited conformance assessments

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Next Steps

- **We have a problem that negatively impacts both supplier and their customers. We need to learn from the past and improve going forward**
- **We need supplier, standards volunteers, other IC maker inputs and participation**
- **Today we presented some ideas**
  - Which ones will have the most beneficial impact?
  - Are there additional things we haven't considered?
- **Need to set priorities, consider tradeoffs: time, resources, quality**
- **Determine roles, responsibilities, and improvements action plan**
- **Join us in identifying and driving the improvements needed that will have long-term, sustaining value**
- **Contact: Jackie Ferrell, jackie.ferrell@sematech.org**

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