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Quality and Efficiency Assurance in Test Development - build the software ecosystem in ATE industry

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Teradyne SEG, China ADC

Virtual ▪ October 26-29, 2021

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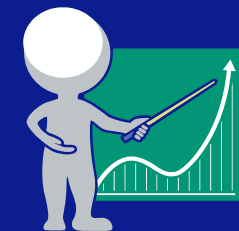
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Test Development Life cycle

After new silicon tapes out to run volume production, test solution development can be depicted in nine stages. Each stage can be sped up while ensuring the quality of test.
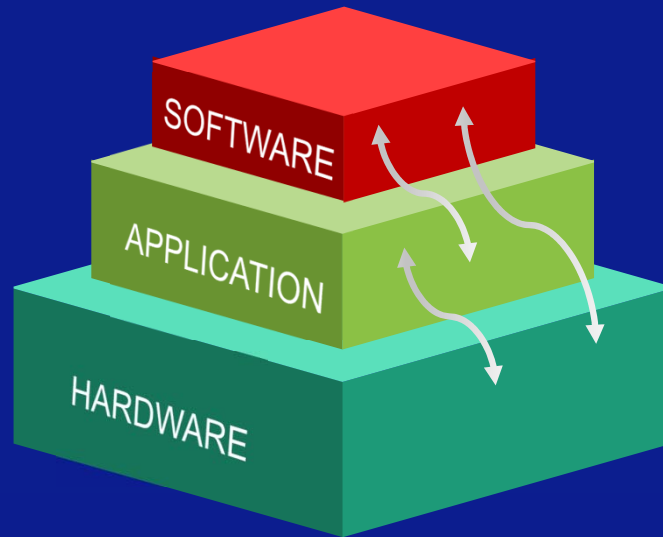
Design → Pattern Conversion → DIB Development → Program Development → Offline Debug → Online Debug → Correlation → Test Time Reduction → Production Release

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ATE Test Development Challenges

Difficult Challenges	Effect & Solution
Increasing device complexity driving more complex test development and significantly higher pattern length.	1. Improve software generation tools
Maintaining Test Program quality	
Complex Test hardware development time	2. Improve offline software quality tools
Lead time to implement design/coverage changes (new or iterating tests)	3. Improve tools to manage software from multiple developers
Accommodating multiple developers working simultaneously	
IP protection / Security requirements limits collaboration and adds delays to test program development	4. Improve handling of large programs and patterns
Automatic Code Generation (Analog and Digital)	

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Software ecosystem in ATE industry

- What was previously used in test development?

- Why is a software ecosystem needed in the ATE industry ?

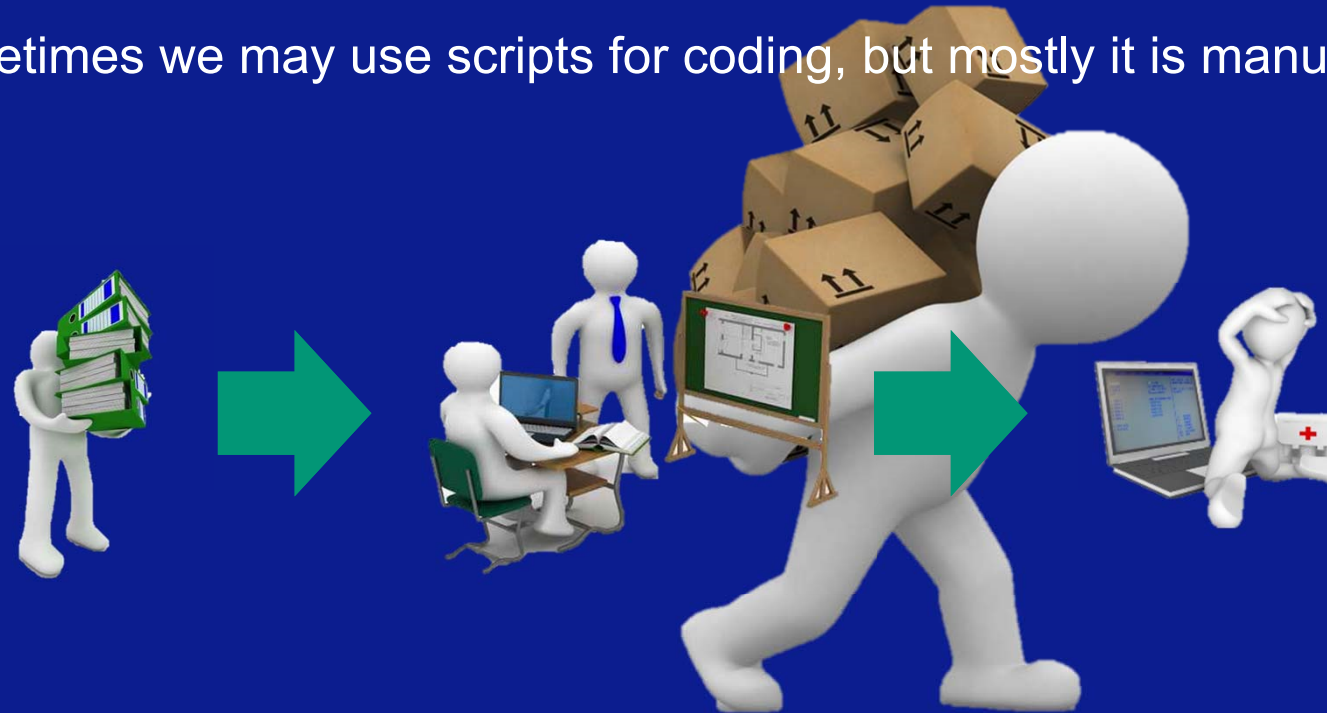- How to build the software ecosystem in test development?

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How do we do test development

- We have a data sheet, create the test plan, and then code and debug

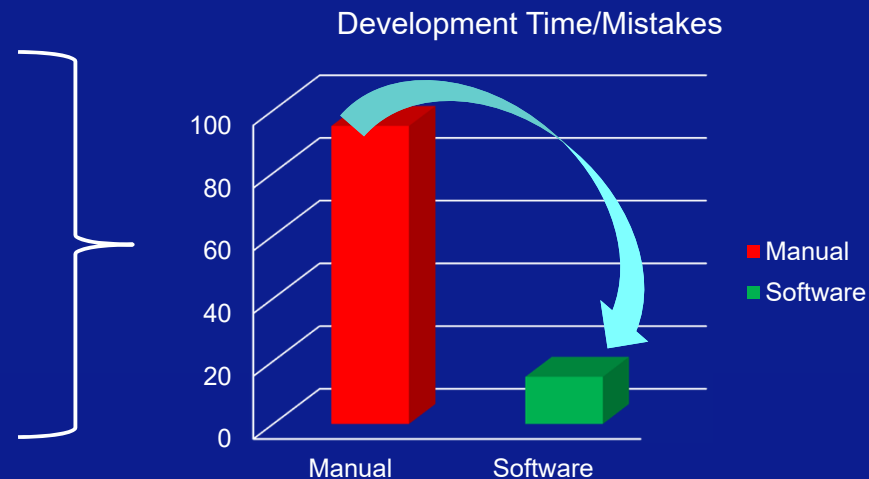- Sometimes we may use scripts for coding, but mostly it is manual work.

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Software ecosystem in ATE industry

Design → Pattern Conversion → DIB Development → Program Development → Offline Debug → Online Debug → Correlation → Test Time Reduction → Production Release

- Design Check
- Convert from design files to test language
- Pattern generator & convertor
- Resource assignments check
- Program Quality Control
- DIB Diagnostics
- Program Optimization
- Datalog Analyze
- Status Logger
- Test Program Auto-Generator
- Test IP Reuse
- Test Program verification
- Production Control

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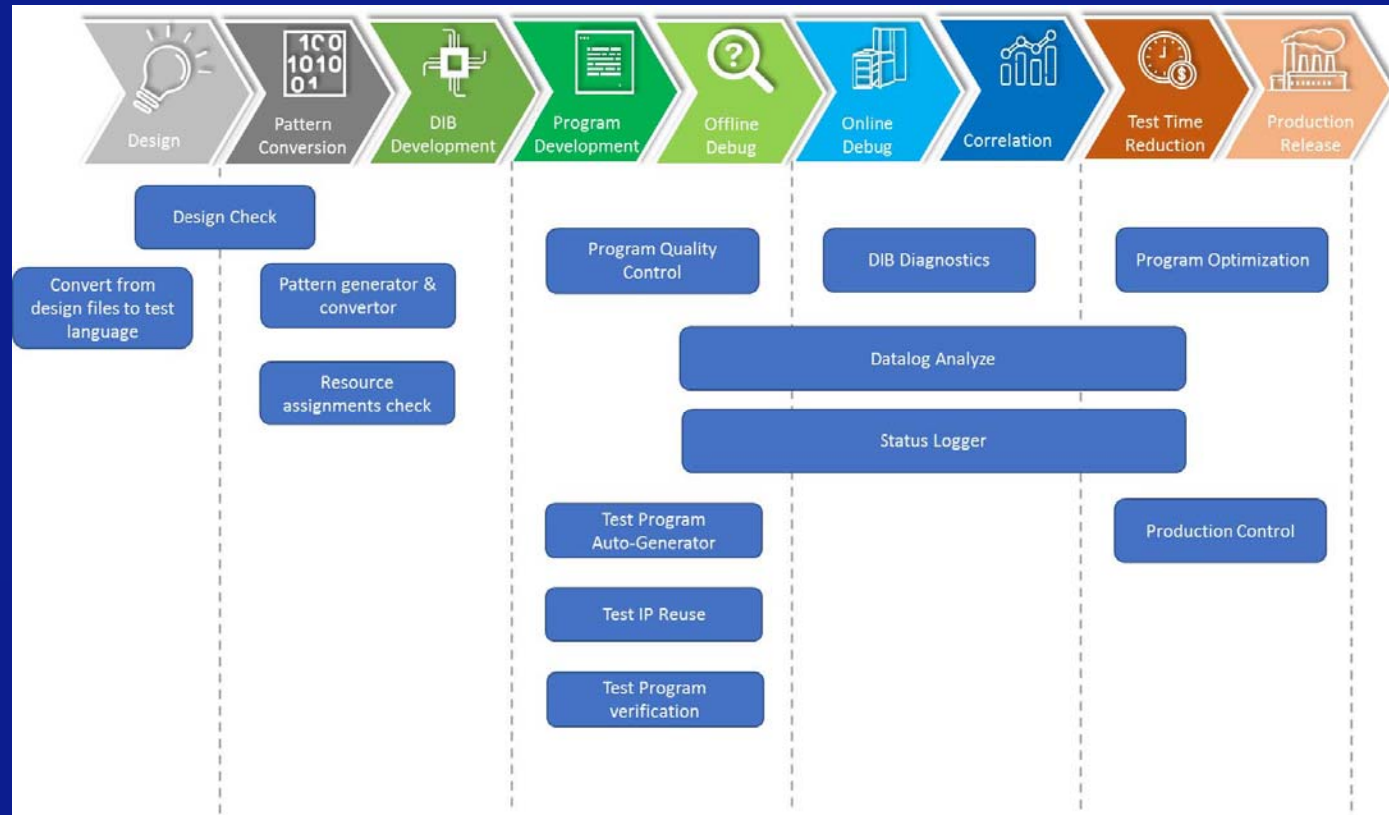
Concept of Test Program Modularity

Version Control

Teamwork
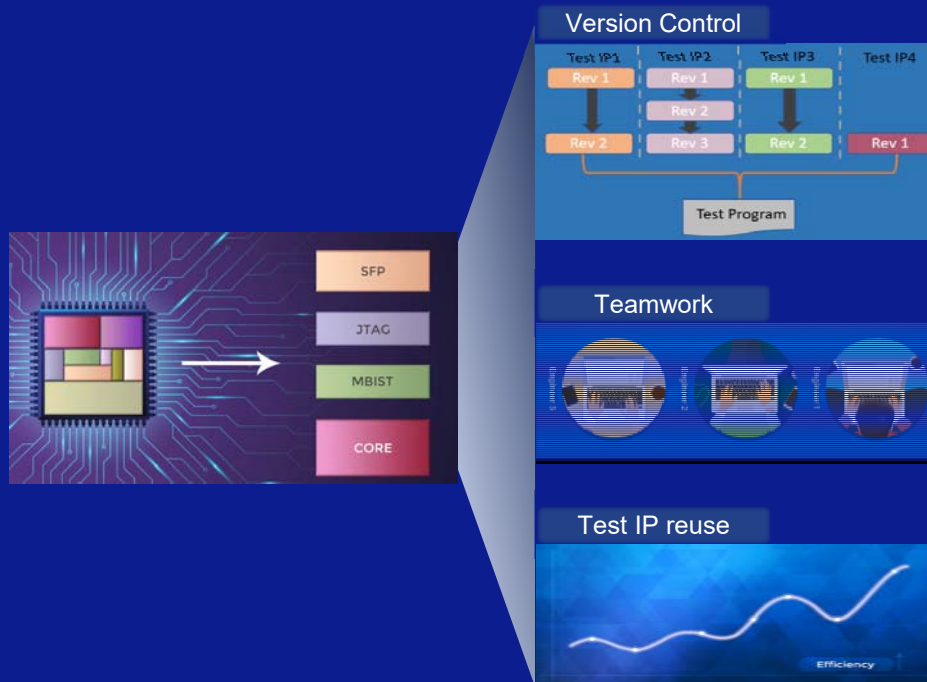
Test IP reuse
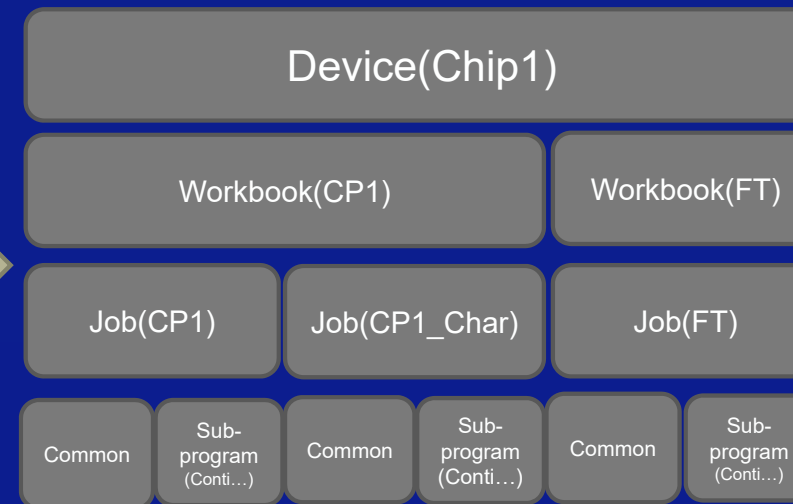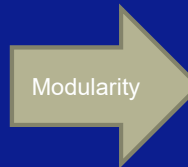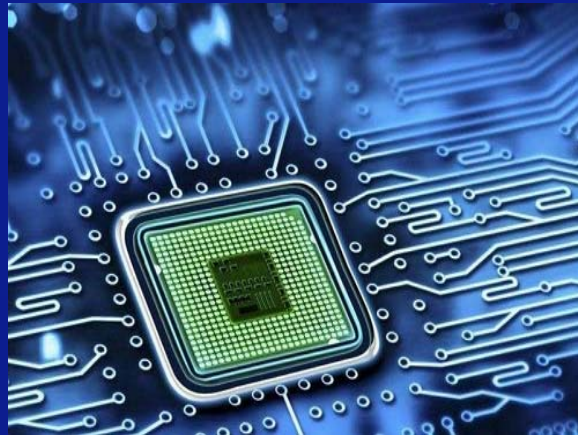
- Version Control
  - Allows each development team to have its unique version control flow

- Teamwork
  - Each module has its own responsible engineers or team.

- Test IP reuse
  - Reuse of test IP can further improve test program development efficiency

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Concept of Test Program Modularity

A software productivity tool breaks down the test program into modules and subprograms according to the functionality of each part

Modularity →

Device(Chip1)		
Workbook(CP1)		Workbook(FT)
Job(CP1)	Job(CP1_Char)	Job(FT)
Common	Sub-program (Conti…)	Common	Sub-program (Conti…)	Common	Sub-program (Conti…)

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Example of Modularity Tool

The Modularity tool needs to manage the whole test program and each of the sub blocks.
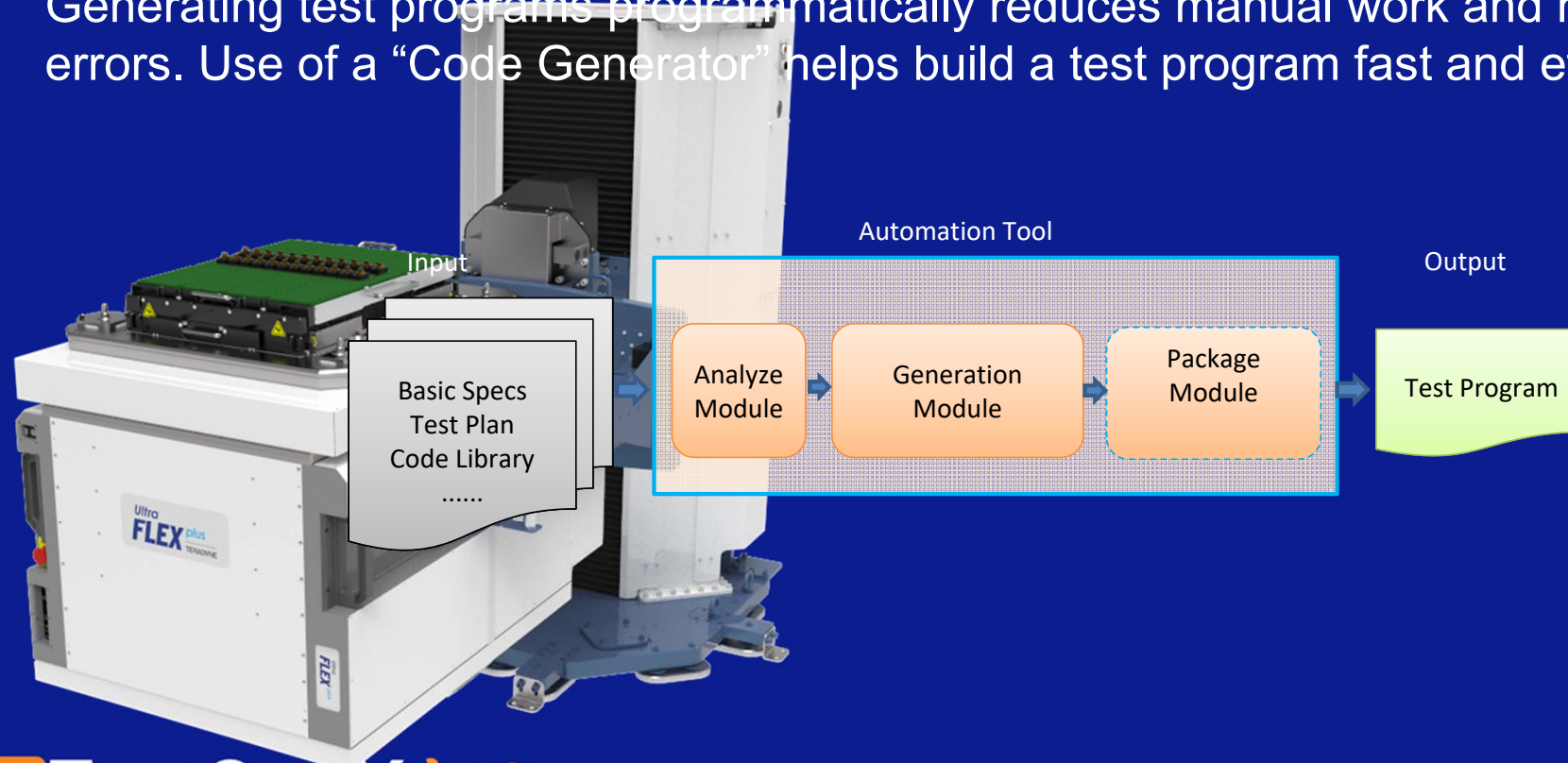

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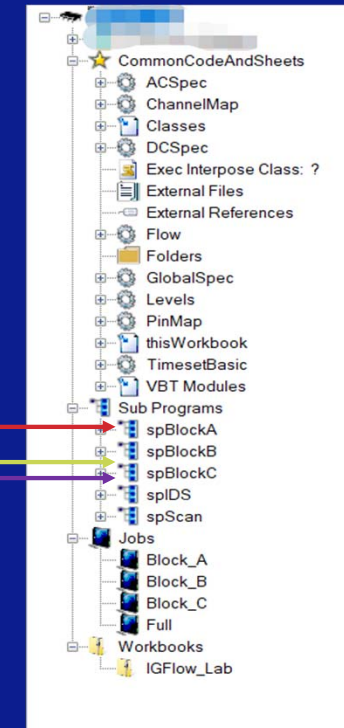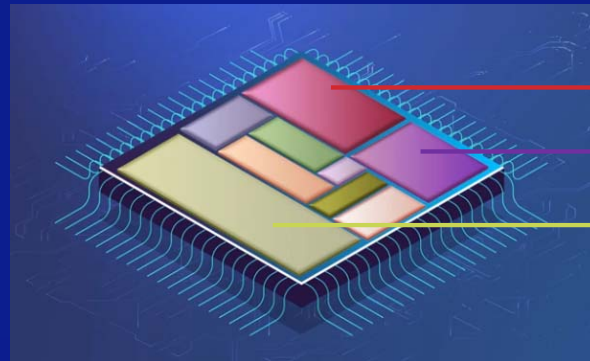
Test Program Automation

Generating test programs programmatically reduces manual work and human errors. Use of a "Code Generator" helps build a test program fast and efficiently

Automation Tool

Input

Basic Specs
Test Plan
Code Library
......

Analyze Module → Generation Module → Package Module

Output

Test Program

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Test Program Diagnostic and Optimize

- Application hardware diagnostic tools
- Identify potential coding errors
- Regression testing of the TP
- Record TP setup and verify test conditions
- Track changes during development
- Production program optimization and characterization tools
- Build customized reports

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Examples of Test Program Diagnostics

Test Program Diagnostics tools review the test program to generate reports that help test engineers identify issues thus increasing test program quality and efficiency.

		Type	Output	Time To Execute	Result	Comment
23	Total Execution Time:	1.7802334 seconds				
24	Time spent gathering flow steps:	0.1495991 seconds				
25	Time spent gathering code records:	0.2204103 seconds				
26	Time spent collecting pattern information:	0.425859 seconds				
27	# of Jobs Reviewed:	1				
28						
29	Report Name	Type	Output	Time To Execute	Result	Comment
30	Audit					
31	Binning Warnings	Audit	No Report Generated	0.6811761 seconds	Passed	No bin warnings detected
32	Undefined Instruments Warnings	Audit	Undefined Instruments Warnings	0.3151571 seconds	Failed	6 issues identified.
33	Unsupported Language	Audit	No Report Generated	0.0668208 seconds	Passed	No use of unsupported APIs identified
34	VBT Warnings	Audit	VBT Warnings	0.1585746 seconds	Failed	5 VBT warnings identified.
35	Optimization					
36	Code Usage	Optimization	Code Usage	0.5485322 seconds	Completed	Successfully generated report
37	Duplicate Sheet	Optimization	No Report Generated	0.6372946 seconds	Passed	No duplicate sheets found
38	Duplicate TName	Optimization	No Report Generated	0.3011934 seconds	Passed	Duplicate TName not found
39	Duplicate TNum	Optimization	No Report Generated	0.5894233 seconds	Passed	Duplicate TNum not found
40	Informational					
41	Conditionally Run Tests	Informational	No Report Generated	0.4248929 seconds	Completed	No conditional tests detected
42	Global Site Variables	Informational	No Report Generated	0.383973 seconds	Completed	No Report Generated. No global site vars found.
43	Patterns By Test	Informational	Patterns By Test	0.3460743 seconds	Completed	Successfully generated report
44	Test Limits	Informational	No Report Generated	0.4936794 seconds	Completed	No limits found

01   Bin usage
02   Subroutine and function call hierarchy
03   Enable words and variable usage
04   Pattern information (version size, checksum, etc.)
05   Test limits and parameters
06   Program size and statistics
07   Test number and name mappings
08   Unused code modules, timings, levels, and patterns, and instances
09   And many more

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How do all these tools become an ecosystem?

Key: Standards & Open Source

Other Productivity Tools

Test Program Modularity Tools

Test Program Diagnostic and Optimization Tools

Other Productivity Tools

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Expectation of ATE industry

- Companies join to create/follow ATE standards such as STDF(*Standard Test Data File*)

- Software developers create/follow ATE software standards, like SEMI E95 (*SPECIFICATION FOR HUMAN INTERFACE FOR SEMICONDUCTOR MANUFACTURING EQUIPMENT*)

- More open-source solutions available in ATE industry

- Software ecosystem is being built across the ATE industry instead of only inside each company

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