A Study of Commercial Industry T&E "Best Practices" as Applicable to DOD T&E

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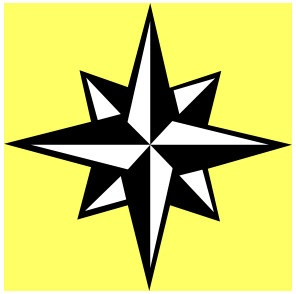
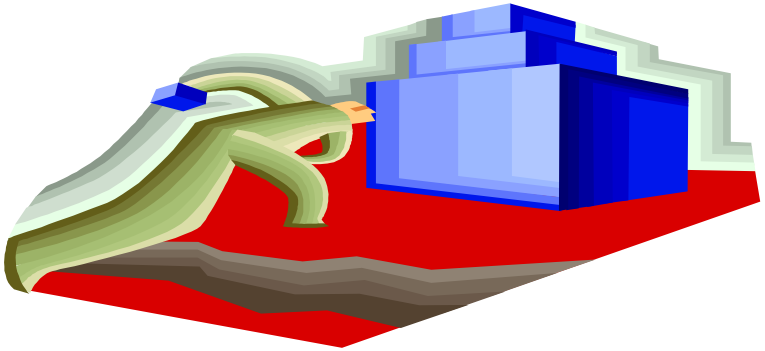


SPONSORSHIP

- Study sponsored by the Deputy Director, Developmental Test and Evaluation, Office of the Under Secretary of Defense (Acquisition, Technology and Logistics)

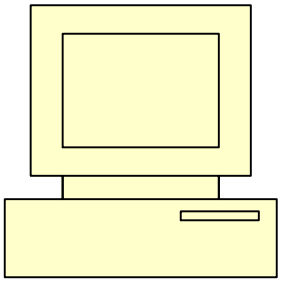
- Study conducted under contract by Science Applications International Corporation.

STUDY OBJECTIVE

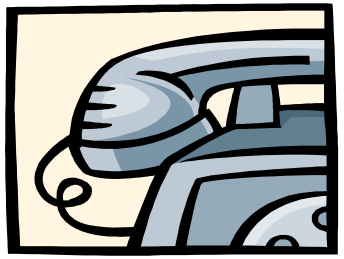


Determine a set of commercial industry test and evaluation “Best Practices” that may have DOD test and evaluation organizational and process applicability.

APPROACH



- Contact commercial organizations known for quality products.
- Establish a framework for discussion.
- Provide advance question sets.
- Conduct visits; follow-up as required.
- Supplement with literature review.



FOCUS

- **Corporate Philosophy, Policy and Approach –** The context in which testing and evaluation is promulgated in corporations.
- **Test Investment –** Investment to acquire and maintain facilities, equipment, instrumentation, people and data.
- **Test Execution –** Planning, conduct, control, data collection and reporting of tests and test results.
- **Test Evaluation –** Planning, control and reporting of data analysis and implications**.**

TECHNOLOGY BREADTH

- Aircraft/Avionics
- Land Surface Automotive Systems
- Sea Surface Systems
- Microprocessors/Computers
- C4I
- Software
- Microelectronics
- Information Systems

COMPANIES VISITED

We appreciate the generous contribution of time, information and insight from:

- Boeing - Commercial Airplane Group
- Boeing - Phantom Works
- Cummins Engines - Corporate Technical Center
- DaimlerChrysler – Corporate Technical Center
- Intel - Performance Microprocessor Division

COMPANIES VISITED

- Lucent Technologies
- Microsoft Office Systems
- Motorola
- Northrop Grumman Corporation Integrated Systems Sector
- Northrop Grumman Ship Systems – Ingalls Operations
- Underwriters Laboratories
- Xerox

GROUND RULES

- Certain “Best Practices” and related information may be proprietary
- No specific identification of best practices by company in the final report.
- Report and briefings are “generic” and reflect a cross-corporate view of the companies

High Implementation

Those commercial best practices that are feasible to implement, have high value for relatively near term implementation AND have direct application to the current development testing adequacy issue.

High Implementation

Philosophy, Policy and Approach

- Recognize that testing is a way to identify and solve problems early in the process in order to control time, cost and schedule late in the process.
- Develop consistent processes to ensure consistent products. Understand the value and cost of T&E.

High Implementation

Philosophy, Policy, Approach

- Increase T&E to ensure product quality rather than reduce it to save cost.
- Ensure T&E is consistently part of the decision, planning and execution process.
- Ensure early commitment by all stakeholders on required T&E resources.

High Implementation

Test Investment

- Ensure early determination of the investment costs to acquire new capability for program support.
- Ensure cohesive (year-to-year) investment plans
- Charge cost of test investment back to the program.

High Implementation

Test Execution

- Involve testers and evaluators very early:
  - Ensures testers know test requirements
  - Ensures developers know requirements for test
- Capture test costs at program initiation.
- Charge full cost of testing to the program.

High Implementation

Test Execution

- Use measurements and metrics.
- Integrate Master Test Plans and test execution with program resources and milestones.
- Establish measures of effectiveness.
- Train the in-house workforce in test engineering disciplines.

STUDY CONCLUSIONS
Best Practices*

Philosophy, Policy, Approach

- Recognize that testing is a way to identify and solve problems early in the process in order to control time, cost and schedule late in the process.
- Recognize that best practices generate success and vice versa.

(* Those briefed High Priority are underlined)

STUDY CONCLUSIONS
Best Practices

Philosophy, Policy, Approach

- Stabilize corporate leadership and test staff and commit to T&E as a key enabler.
- Focus on quality of product and process to drive the efficiency and effectiveness of T&E.
- Develop consistent processes to ensure consistent products. Understand the value and cost of T&E.

STUDY CONCLUSIONS
Best Practices

Philosophy, Policy, Approach

- Implement efficient and effective test processes in order to compete. Keys:

  - Ensure T&E is consistently part of the decision, planning and execution process.

  - Early commitment by all stakeholders on required T&E resources.

  - Certification of T&E processes and organizations (~ISO 9000)

  - Ensuring capital capability.

STUDY CONCLUSIONS
Best Practices

Philosophy, Policy, Approach

- Increase T&E to assure product quality rather than reduce it to save T&E cost.
- Use metrics and quality control processes to understand how well the test process is operating.

STUDY CONCLUSIONS
Best Practices

Test Investment

- Ensure early determination of the investment costs to acquire new capability for program support.
- Require analytically sound ROI analysis for test investments.
- Ensure cohesive (year-to-year) investment plans.
- Charge cost of test investment to program

STUDY CONCLUSIONS
Best Practices

Test Execution

- Involve testers and evaluators very early:
  - Ensures testers know test requirements
  - Ensures developers know requirements for test
- Capture test costs at program initiation.
- Emphasize concurrent and integrated T&E.
- Institute formal quality check processes.

STUDY CONCLUSIONS
Best Practices

Test Execution

- Use System Integration Laboratories and embedded instrumentation.
- Give proper consideration to the use of external test capability in test planning.
- Ensure testers control test planning, equipment, facilities, instrumentation and test resources.

STUDY CONCLUSIONS
Best Practices

Test Execution

- Continue to increase the use of modeling and simulation to expand the test process.
- Do not generally support the outsourcing of testing and evaluation.
- Frequently use the Six Sigma (6σ) or similar quality processes.
- Automate data collection and archiving.
- Benchmark in-house and within industry.

STUDY CONCLUSIONS
Best Practices

Test Execution

- Use measurements and metrics.
- Initiate programs to seek ten-fold reductions in the number of software tests required.
- Integrate Master Test Plans and test execution with program resources and milestones.
- Charge full cost of testing to the program.

STUDY CONCLUSIONS
Best Practices

Test Execution

- Establish measures of effectiveness.
- Quantify risk for management decision when considering reduced testing.
- Train the in-house test workforce in test engineering disciplines.
- Emphasize multi-use T&E platforms.

STUDY CONCLUSIONS
Best Practices

Test Evaluation

- Continue to increase the use of modeling and simulation to expand the evaluation context based on verified test data.
- Correlate faults and solutions in a closed loop process to ensure problems are resolved
- Use Physics of Failure as a tool to predict and analyze system performance and shortfalls.

STUDY CONCLUSIONS
Best Practices

Test Philosophy/Process/Evaluation

(A combined category)

- Establish corporate internal web based sites for exchange of ideas, benchmarks, data, applications and processes. Address:
  - Data collection retrieval/archiving.
  - Modeling and Simulation.
  - Test and Evaluation methods

RECOMMENDATIONS

- Develop implementation or reinforcement strategies and implement or reinforce the High Priority Best Practices in DOD as soon as possible.
- Follow with implementation of the remainder of the Best Practices as resources permit.
- Present the results of this study to the DOD acquisition and T&E communities.