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Test Planning – Advancing the Science Tutorial

27th Annual National T&E Conference

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Test Planning –Advancing the Science

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- Agenda
  - Some opening thoughts
  - Why develop a Test Plan?
  - What is a Test Plan?
  - What do you plan?
  - Where does a Test Plan's data come from ?
  - How do we plan?
    - Verification
    - Safe testing
    - Test Techniques
    - Test Tools
    - Test resources
  - Keeping it all straight
  - Let's Plan
  - Conclusions

"Let our advance worrying become advance thinking and planning"
Winston Churchill

Test Planning

- "Approximately 20%-30% of the overall projects work should be allocated to testing."

- "Regardless of how much testing is allocated for the project, it is important to note that acceptable test results do not necessarily require perfection. Acceptable testing is more about validating what is agreed to be done rather than being perfect or even exceeding expectations."
  - Harold Kerzner's book Project Management a Systems Approach to Planning, Scheduling, and Controlling John Wiley & Sons, Inc

STAY ON TARGET

Remember This?

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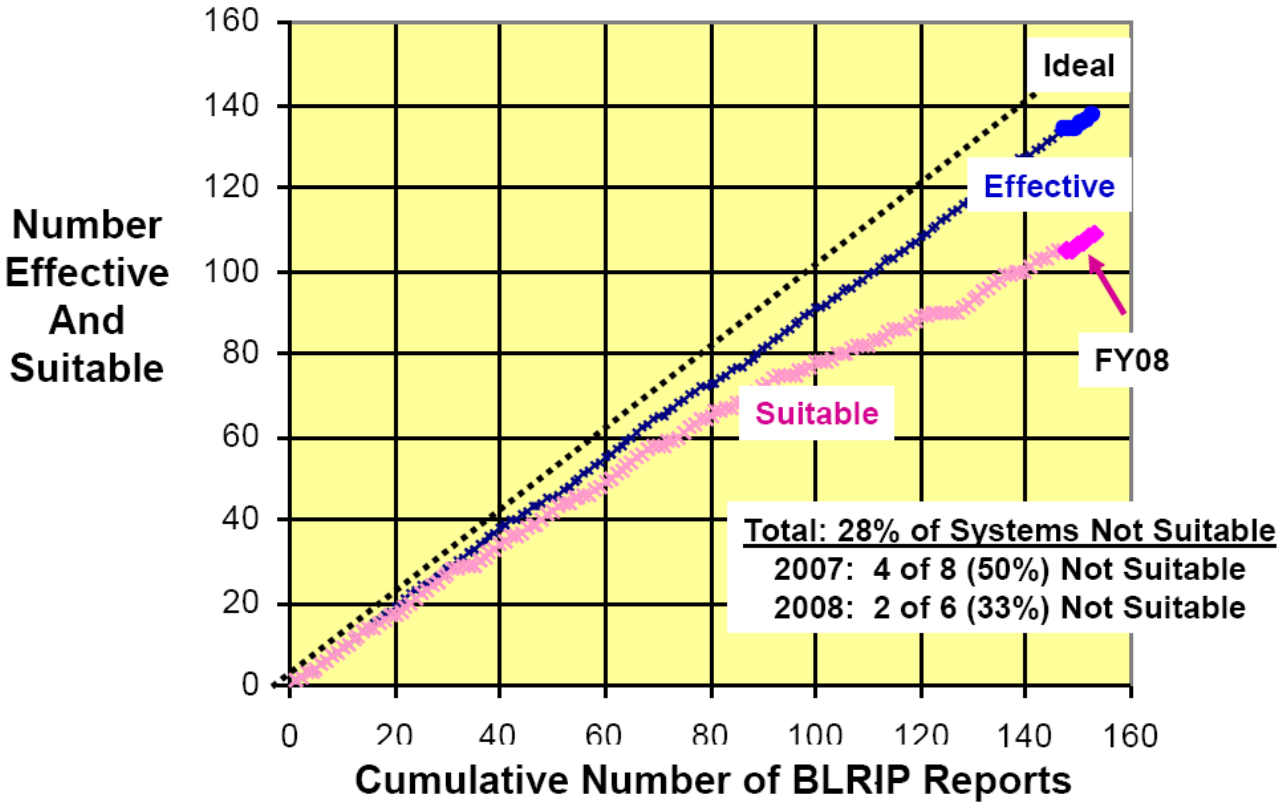
Cumulative IOT&E Results Through FY 2008



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NDIA 11th Annual System Engineering Conference Proceedings, Keynote Presentation, HON Charles McQueary, Director, Operational Test & Evaluation - October 2008

Tutorial Description

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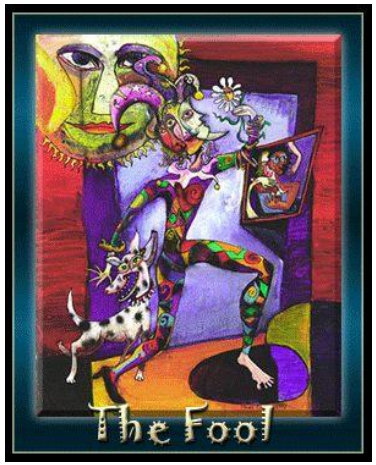
- From verification to test plan modeling and test plan generation, participants will see the processes and tool sets in action.
- To demonstrate some of these capabilities, participants will generate test requirements and objectives, model the plan, optimize the plan and assign resources, and finally generate a simple test plan while maintaining connections to the original requirements intent.
- Fools rush in
  Where wise men never go.



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Tutorial Style

INTERACTIVE

IDEA SHARING

TEAM EXERCISES

Why Develop a Test Plan ?

How Do Plans Help The Program?

- Identifies the test program and test program resources
- Provides a method to manage the test program

- Optimized test plan saves program cost
- Ensures the test program is traceable to the product architecture (requirements)

- Test plan can help manage program changes
- Test plans foster communications

Advancing the Science

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- Test planning typically relies on
  - Experience
  - Requirements
  - DWWDLT (Did What We Did Last Time)
  - Lessons learned
  - Working teams / meetings
  - Schedules

- Test planning must advance using:
  - Experience
  - Doing what is required (optimizing the test program)
  - Working teams / meetings
  - Schedules
  - Test plan modeling (utilizing SE based tool set)
  - Appropriate application of design of experiments
  - Collaborative techniques and tools to encompass the entire programs test program
  - Support rapid evaluation based on programmatic changes

Why Do We Plan?

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- Planning allows one to stay on target, project the future, and assess the impact of change.

- Planning identifies problems and points the way to solutions. Just taking a systematic, thorough look at the current situation and thinking about the implications for the future, can bring these things to light.

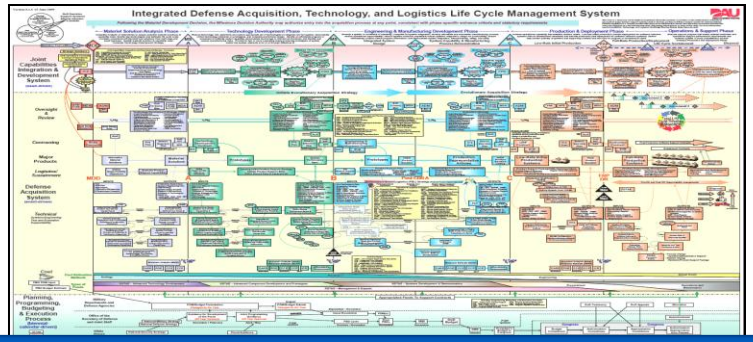
- It helps us to do first things first. In other words, it provides a rationale for assigning priorities.

- A good plan will suggest answers to perplexing questions.

Planning is "intelligent cooperation with the inevitable."

The TEMP Lifecycle Value

- The TEMP identifies and integrates all of the T&E requirements with the program's acquisition strategy and requirements. The temps for OSD oversight programs follow the DAG format and must be approved by the director, DT&E and the director, OT&E. Service approved temps are developed according to service regulations and guidance. The TEMP is used by the program office to:
  - Provide an overall test management plan within the acquisition strategy bounds,
  - Identify overall T&E activities by the government and system contractor,
  - Guide the development of specific test events and integration of detailed test plans for those activities by summarizing relevant performance requirements, and
  - Document T&E schedule and resource requirements



ACQuipedia - https://acc.dau.mil/ILC_T&EMP
Defense Acquisition University Web Site

Test Planning is a Lifecycle Event – Programs Must Not Dismiss the Test Plan Importance

What is a Test Plan?

What Is A Test Plan?

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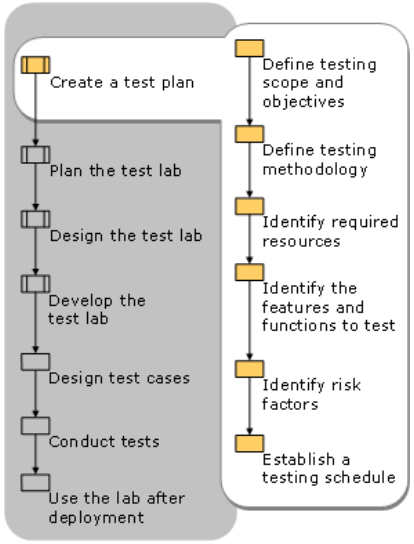
Microsoft



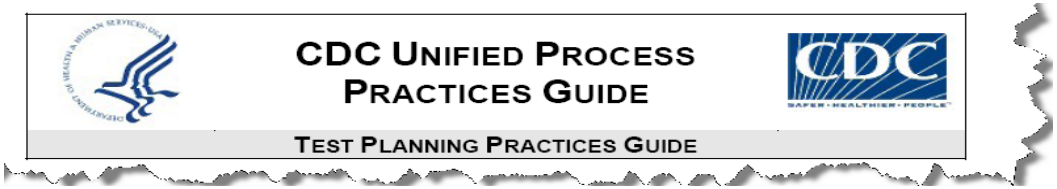
Early in the deployment planning phase, the testing team creates a test plan. The **test plan defines the objectives and scope of the testing effort, and identifies the methodology that your team will use to conduct tests**. It also **identifies the hardware, software, and tools required** for testing and the features and functions that will be tested. **A well-rounded test plan notes any risk factors that jeopardize testing and includes a testing schedule.**

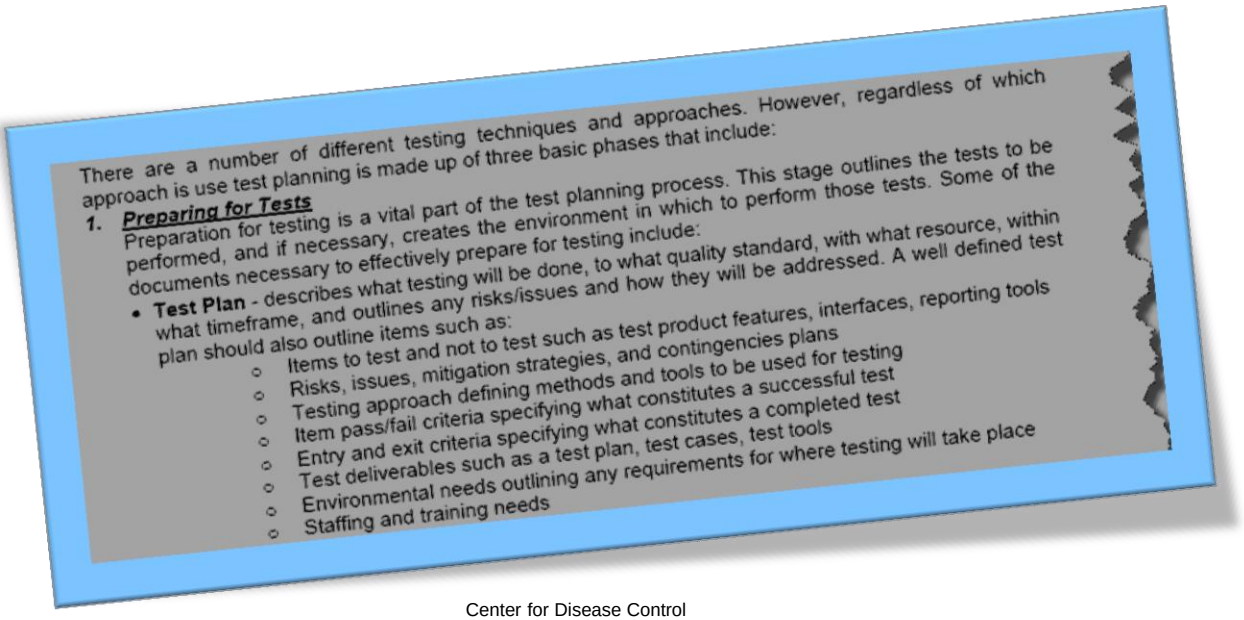
TABLE OF CONTENTS

Microsoft Tech Net
http://technet.microsoft.com/en-us/library/cc781572(WS.10).aspx

http://technet.microsoft.com/en-us/library/ee221154(EXCHG.80).aspx

What Is A Test Plan?





There are a number of different testing techniques and approaches. However, regardless of which approach is use test planning is made up of three basic phases that include:

1. ***Preparing for Tests***

Preparation for testing is a vital part of the test planning process. This stage outlines the tests to be performed, and if necessary, creates the environment in which to perform those tests. Some of the documents necessary to effectively prepare for testing include:

- **Test Plan** - describes what testing will be done, to what quality standard, with what resource, within what timeframe, and outlines any risks/issues and how they will be addressed. A well defined test plan should also outline items such as:
  - Items to test and not to test such as test product features, interfaces, reporting tools
  - Risks, issues, mitigation strategies, and contingencies plans
  - Testing approach defining methods and tools to be used for testing
  - Item pass/fail criteria specifying what constitutes a successful test
  - Entry and exit criteria specifying what constitutes a completed test
  - Test deliverables such as a test plan, test cases, test tools
  - Environmental needs outlining any requirements for where testing will take place
  - Staffing and training needs

Center for Disease Control
2007
http://www2.cdc.gov/cdcup/library/practices_guides/CDC_UP_Test_Planning_Practices_Guide.pdf

INTRODUCTION
Purpose of The Test Plan Document
Compatibility testing
Test Risks / Issues
Items to be Tested / Not Tested
Test Approach(s)
Test Regulatory / Mandate Criteria
Test Pass / Fail Criteria
Test Entry / Exit Criteria
Test Deliverables
Test Suspension / Resumption Criteria
Test Environmental / Staffing / Training Needs
Conformance Testing
Functional Testing
Load Testing
Performance Testing
Regression Testing
Stress Testing
System Testing
Unit Testing
User Acceptance Testing
Test Plan Approval
Appendix A: References
Appendix B: Key Terms

Each *subsection* is repeated in each major section

www2.cdc.gov/cdcup/library/templates/CDC_UP_Test_Plan_Template.doc

What Is A Test Plan?

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The TEMP describes the acquisition program's planned T&E over the program's life cycle and identifies evaluation criteria for the testers. It serves as an executive summary of the overall test program. Building on the foundations laid in the TES, the TEMP identifies and integrates all of the T&E requirements with the program's Acquisition Strategy and requirements

DOD / Air Force TEMP TOC – 2 Levels Deep

PART 1 – INTRODUCTION
1.1PURPOSE
1.2MISSION DESCRIPTION
1.3SYSTEM DESCRIPTION

PART III – TEST AND EVALUATION STRATEGY
3.1T&E STRATEGY
3.2 EVALUATION FRAMEWORK
Figure 3.1 – Top-Level Evaluation Framework Matrix
3.3 Developmental Evaluation Approach
3.4 Live Fire Evaluation Approach
3.5 Certification for IOT&E
3.6 Operational Evaluation Approach
3.7 OTHER CERTIFICATIONS
3.8 RELIABILITY GROWTH
3.9 FUTURE TEST AND EVALUATION

PART II – TEST PROGRAM MANAGEMENT AND SCHEDULE
2.0 T&E MANAGEMENT
2.1.1T&E Organizational Construct
2.2Common T&E Data Base Requirements
2.3DEFICIENCY REPORTING
2.4 TEMP UPDATES
2.5INTEGRATED TEST PROGRAM SCHEDULE
Figure 2.1 – Integrated Test Program Schedule

PART IV – RESOURCE SUMMARY
4.1 Introduction
4.1.1Test Articles
4.1.2Test Sites and Instrumentation
4.1.3Test Support Equipment
4.1.4Threat Representation
4.1.5 Test Targets and Expendables
4.1.6Operational Force Test Support
4.1.7Models, Simulations, and Test-beds
4.1.8Joint Operational Test Environment
4.1.9Special Requirements
4.2 Federal, State, Local Requirements
4.3 Manpower/Personnel Training
4.4 Test Funding Summary
Table 4.1 Resource Summary Matrix
APPENDIX A – BIBLIOGRAPHY
APPENDIX B – ACRONYMS
APPENDIX C – POINTS OF CONTACT
ADDITIONAL APPENDICES AS NEEDED

What do We Plan?

What Do We Plan ?

- Tenet
  - a widely held belief; *especially* **:** one held in common by members of a group or profession
- Feature
  - a part or detail that stands out

Define the tenets and features of a good test plan.

Break Into Teams

- **Select a Spokesperson**
- **Develop 3 – 4 Key Tenets Of a Good Test Plan**
- **Develop 3 – 4 Key Features of a Test Plan**
- **Write Them Down**
- **Share With Community**

What Do We Plan ?

- Tenets of a Good Test Plan
  - Defines Test Strategy
  - Establishes Test Program Management
  - Documents the Test Program
  - Identifies the Needed Resources

- Features of a Good Test Plan
  - Can be used to manage the test program lifecycle
  - Covers all program level test responsibilities
  - Traceable
  - Adjustable
  - Is used as the requirements document for test procedures
  - Avoids obsolescence

The Test Plan is the Test Procedure's Requirement Document

Tenet Characteristics - Strategy

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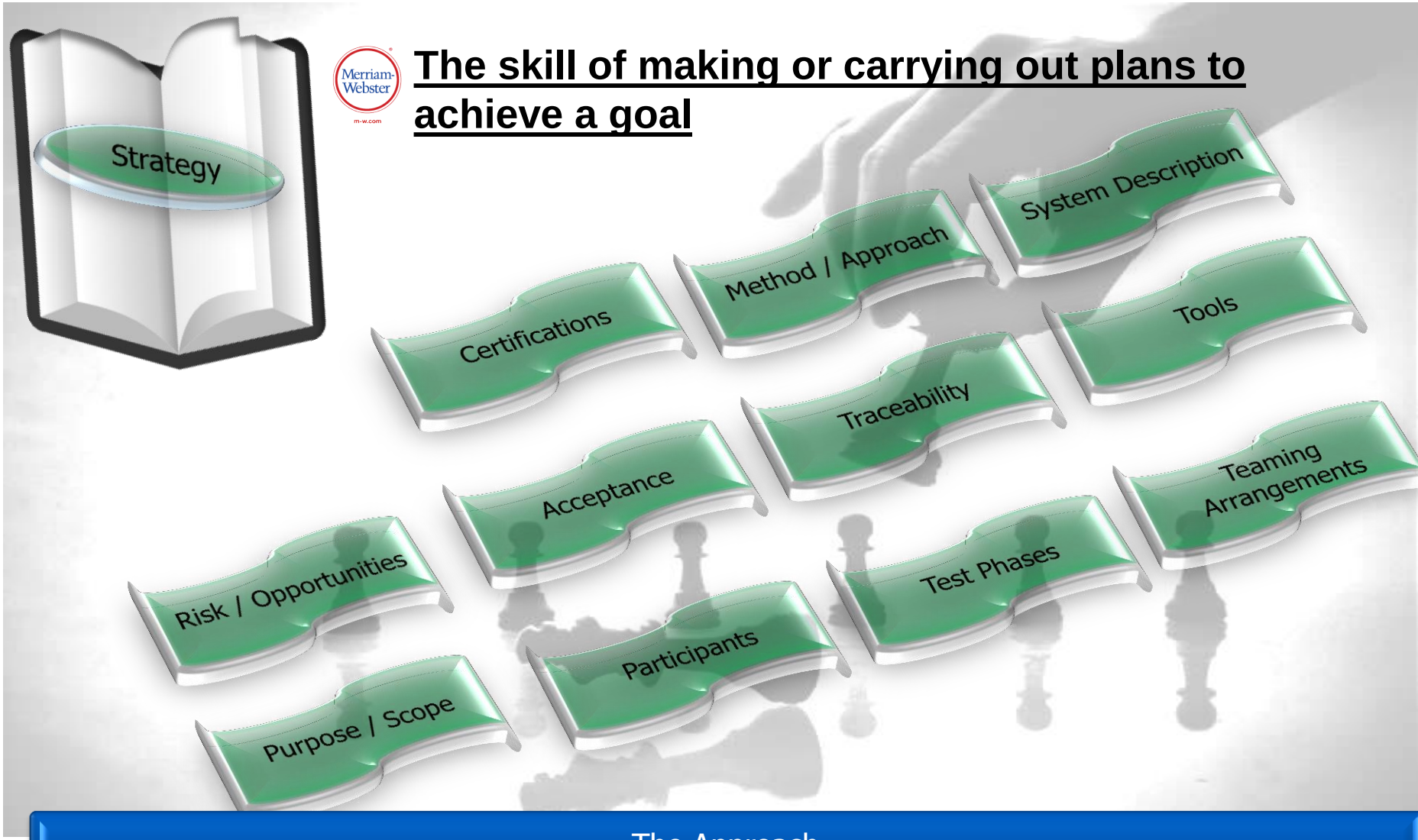

Tenet Characteristics - Management

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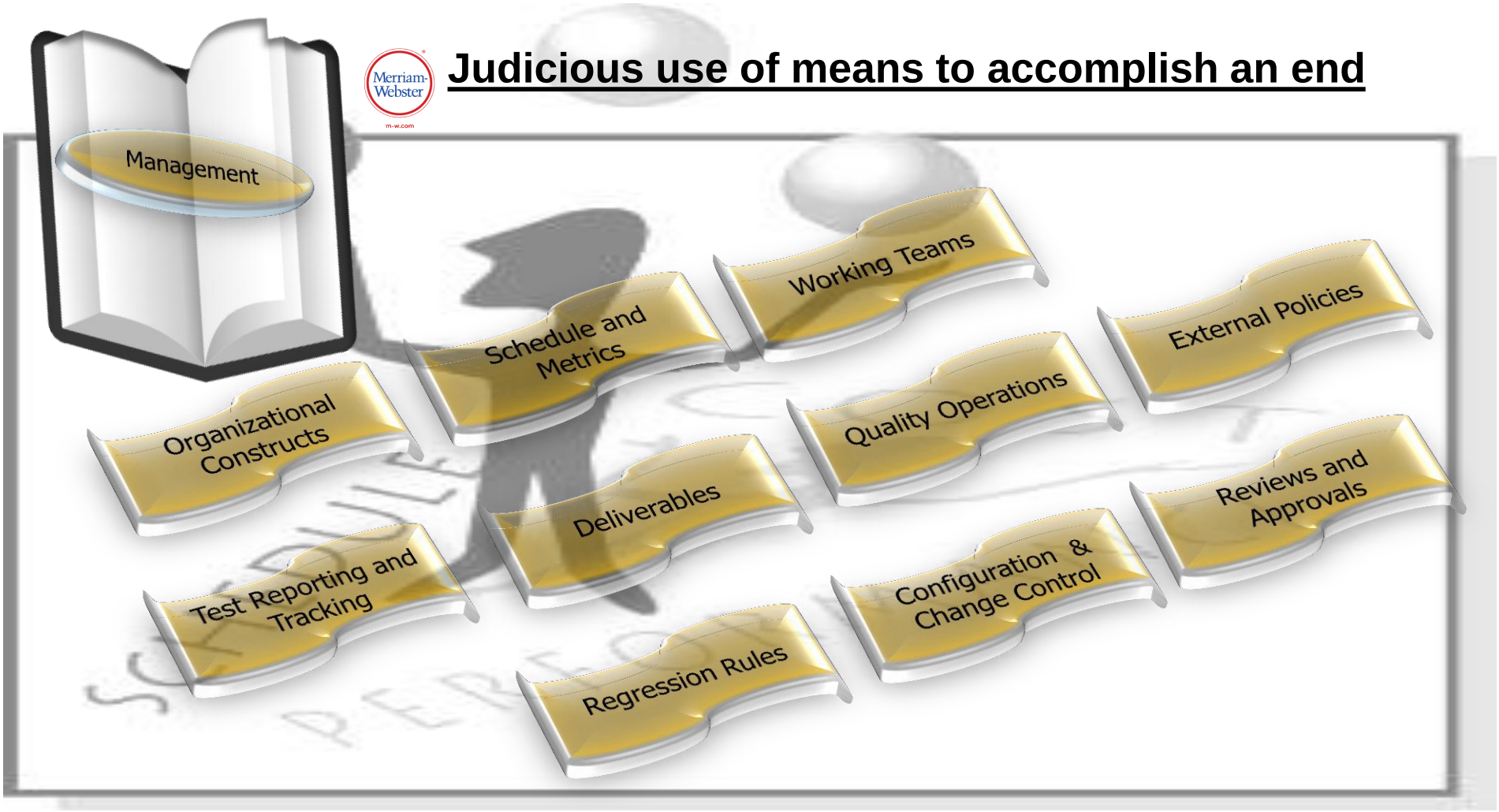

Test Program Controls

Tenet Characteristics - Program

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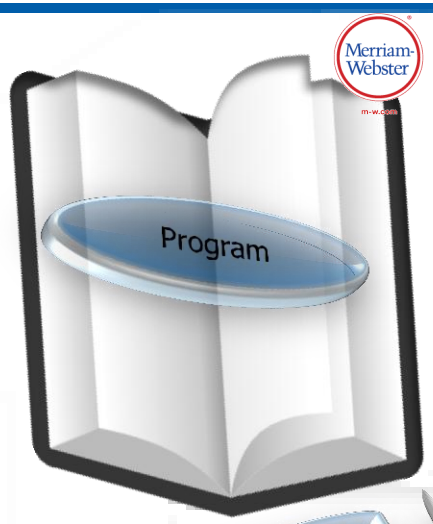

A planned, coordinated group of activities, procedures, etc., often for a specific purpose, or a facility offering such a series of activities

Design Support
Opportunities
Documentation
Risk
Test Process
Test Activities
Test Levels
Verification Tasks
Exchange Points
Test Phases
Roles and Responsibilities
Supplier
Contractor
User
SoS
Contractor
DT
OT
Live Fire
Data Requirements

Detailed Program Activities

Tenet Characteristics - Resources

Test Facilitators

Tenet Alignment ?

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Tenet	Microsoft	CDC	DoD
Strategy	Test scope Lab test goals Not in test scope	Test Approach(s) Items to be Tested / Not Tested	Part 1&2
Management	Metrics Schedule (Embedded)	Test Entry / Exit Criteria Test Deliverables Approval Schedule (embedded)	Part 3
Program	Success criteria (objectives) / critical metrics risk factors Use cases	Test Pass / Fail Criteria Test Risks / Issues	Part 2
Resource	Lab test participants Test tools	Test Environmental / Staffing / Training Needs	Part 4

Test Plans Have Common Tenets Across Much of Industry and Government

Test Plan Data Sources

A Excerpt From The DAU T&E Course

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- Test personnel must keep in mind that system test and evaluation is not limited to the technical performance of hardware and software.
- Evaluation of a complete system can include a wide range of factors, such as requirements, support requirements, arming distance, and weight.
- Evaluation of a complete system must include a wide range of factors in additional to purely technical ones, such as: training and human factor requirements, supportability and maintainability, facilities, etc.

DAU Fundamentals of Test and Evaluation Course Tst 102- Evaluation Considerations

Test Plan Input Sources
Military Program

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Source	Owner	Characteristic	Product	Test Plan Input
Operational Need	Sponsor	COIC, CTPs, Objectives & Thresholds	CDD, Evaluation Criteria	Measures of Effectiveness Key Performance Parameters
Test Strategy	Sponsor / Contractor	Environment	TES/TEMP/User	Test Conditions Resources
Requirements	SE	Compliance Criteria / Methodology	Specifications	Verification Criteria
Policies	Government / Sponsor Agencies/ Contractor	Environmental Concerns Accepted Approaches	Policies Standards Directives SEP	Accepted Test Approaches
Test Experience	T&E	Safe & effective test techniques	Lessons Learned, Previous Program Documentation	Test Techniques
Tech Maturation Plan	Design/ Eng	Risk Opportunities Tech Maturation	Tech Maturation Plan Risk Plan	Design Development Test Requirements
Manufacturing Strategy	Manufacturing	Acceptance Criteria	Manufacturing Plan	Testability Requirements Tools

When Do You Test Plan?

Does any of this Sound Familiar?

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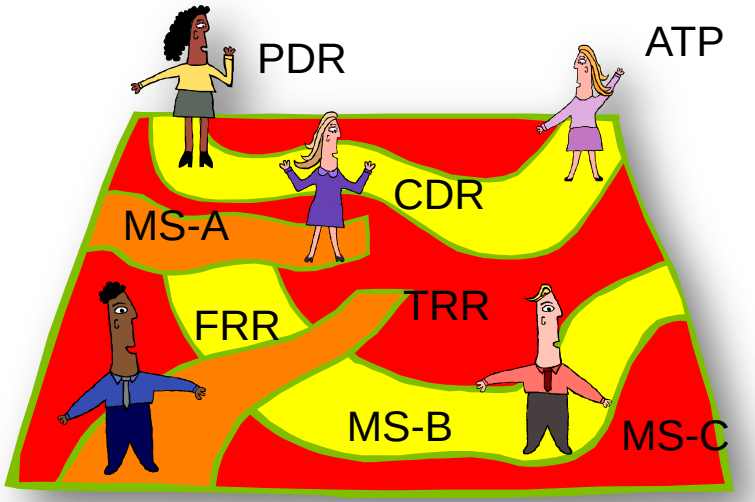
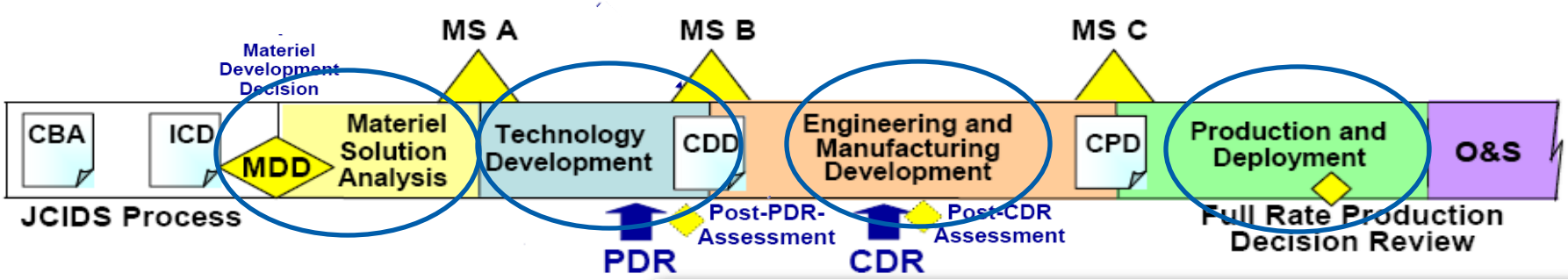
- How do You Plan for Testing?
  - We plan as we go
  - Our ITP / Master Test Plan is the Strategic Guide for the Test Program, we develop lower tiered plans for the detailed facility dependant tasks
  - We don't write an ITP we rely on the lowered tier plans
  - We write only what is necessary to get through the milestone delivery
  - The ITP / MTP is valid until CDR or it's equivalent
  - We use our program schedule as our test plan

- When do you Plan for Testing?
  - We build a strategic plan for early program milestones (PDR or later)
  - Our lower tier plans are developed before the test TRR
  - Once the lower tier plans are developed we rely on the test procedures to adjust the plan as necessary



When Do We Plan



Break Into Teams

- Select a spokesperson
- Establish key test planning inputs by program phase
- Establish phases for TES, TEMP, contractor plan, DT&E and OT&E plans
- Decide the state (draft, 1st release, final, etc;) of the test strategy / plan at each program milestone
  - Ms-A, MS-B, MS-C, PDR, CDR, etc;
- Write them down
- Share with community

Test Planning- A Lifecycle Look

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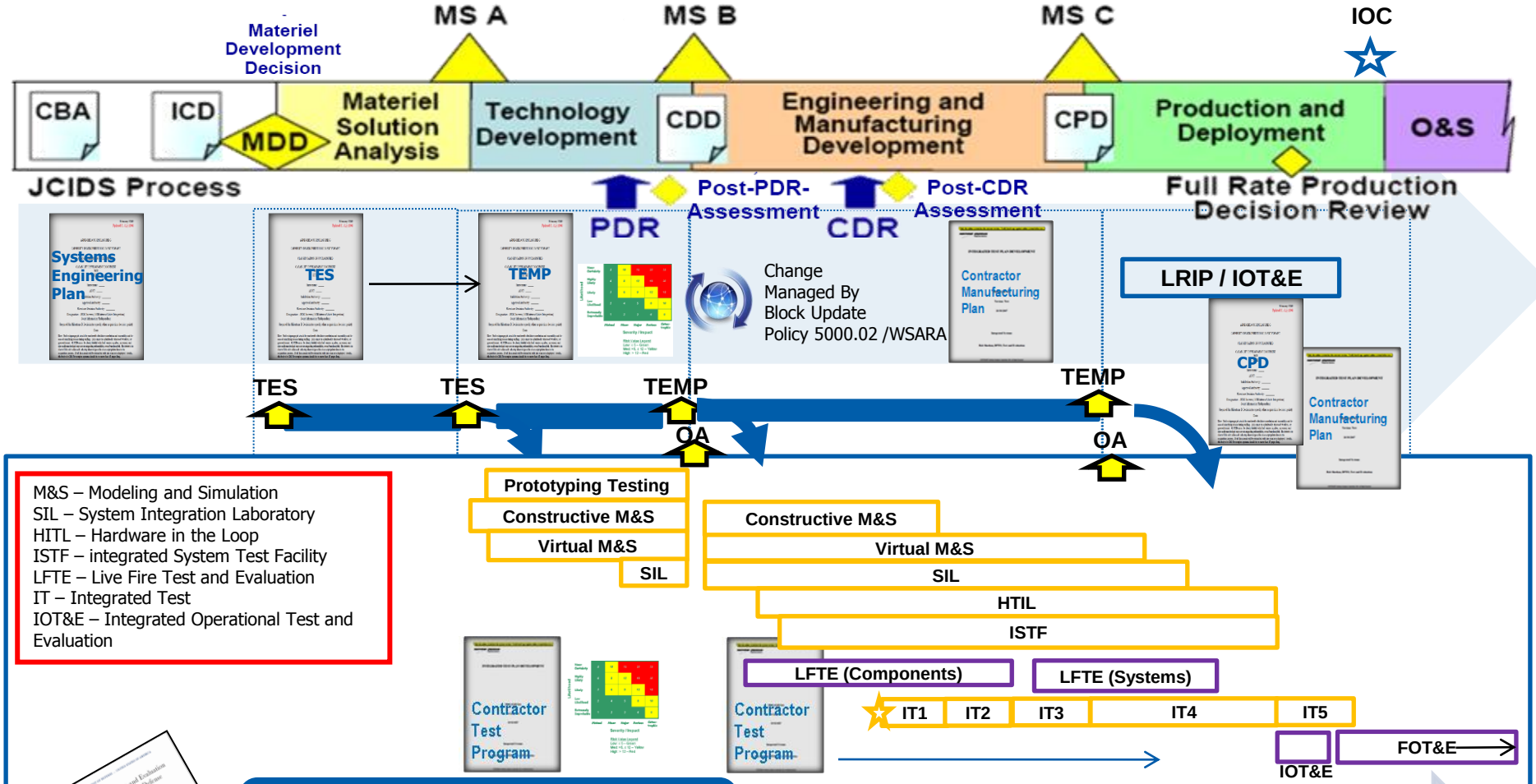

T&E

- **"….incorporation of T&E considerations and requirements begins at the onset of program planning during the Material Solutions Analysis and TD phases"** (paragraph 2.1 Incorporating Test and Evaluation into Department of Defense Acquisition Contracts)

Intent must be maintained throughout the programs lifecycle to ensure warfighter need is provided

Test Planning – Advancing the Science

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- Test planning starts at program inception
- Test planning support the development of product architecture and requirements
- Test planning requires the proper skill mix with lifecycle experience
- Test planning is a lifecycle task
- Test planning requires a collaborative, program integrated, model based tool set.
- Test planning should look front to back and not back to front
- Test planning should help decide the test techniques, not the other way around.
  - Just because you used a laboratory last time doesn't mean you need it this time.

How Do We Plan ?

How Do We Plan

- Pick a Planning Method(s)
- Pick a Planning Tool(s)
- Apply Experience
- Get Lessons Learned and Other Program Experience
- Get User Input

- Understand the Available Test Techniques
- Understand the Verification Needs
- Learn the Policies
- Determine the Sequences and Prerequisites
- Write it all Down

How Do We Plan?

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- Consider an improved air-to-air missile system that requires testing—Missile A Improved. Suppose the original Missile A had an historical hit rate of 70%. The test design must evaluate whether the improved missile is at least equal to or better than the original in “target hit” success. How many shots do we need to make to determine the performance of the improved Missile A?

- Starting with a blank sheet of paper, the test engineer must define the appropriate number. But what is the number of shots necessary to verify the improved Missile A. Maybe the number is 3, because that is what the available time or money will support. Maybe the number is 8 because the engineer just likes 8. Maybe the number is 10 because the engineer is challenged by fractions. Or maybe the number is 30 because in life something good happens at 30! There is no statistical backing for any of these numbers, but all remain possibilities. For no particular reason, the engineer chooses 10.

Design of Experiments Applied to Flight Testing - Leslie L. Bordelon
U. S. Air Force Senior Executive Service Retired - RTO-EN-SCI-176

Traditional Test Planning Methods

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- Test Team Planning Approach
  - Intuition – SME opinions, Quick and Easy, Not Much Detailed Planning Required
  - Do What We Did Last Time (DWWDLT) – Defined Trade Space, Cost and Schedule, May Not Examine New Capabilities Under Changed Environment
  - One Factor at a Time (OFAT) – Organized, repeatable, Non-interactive
  - Best Guess – Cost and Schedule Driven
  - Use Comparable Data – Adds Supporting Data, Lacks Fidelity to New Case

During the 1920s, a British statistician named Ronald Fisher put the finishing touches on a method for making breakthrough discoveries. Some 70 years later, Fisher's method, now known as design of experiments, has become a powerful tool for engineers and researchers.

Design of Experiments ?

Design Of Experiments

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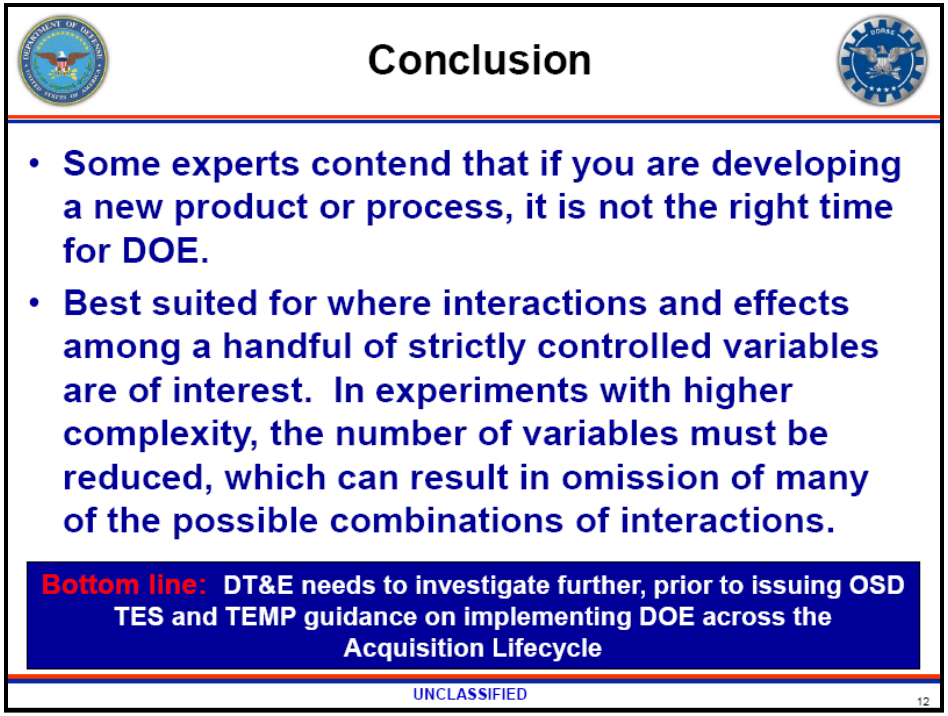
"The 53d Wing (53 WG) of Air Combat Command (ACC) at Eglin Air Force Base (AFB), Florida, has used experimental design on over 25 operations in the past 14 years."

Design of Experiments Applied to Flight Testing Leslie L. Bordelon U. S. Air Force Senior Executive Service Retired RTO-EN-SCI-176

"As I review Test and Evaluation Master Plans (TEMPs) and Test Plans, I am looking for specific information. In general, I am looking for substance vice a 'cookbook' or template approach -each program is unique and will require thoughtful tradeoffs in how this guidance is applied. A "designed" experiment is a test or test program, planned specifically to determine the effect of a factor or several factors (also called independent variables) on one or more measured responses (also called dependent variables)."

Guidance on the use of Design of Experiments (DOE) in Operational Test and Evaluation J. Michael Gilmore Director OT&E 10-19-2010



Use of Design of Experiments to Determine the Critical Technical Parameters and Evaluation Framework in the T&E Strategy Darleen Mosser-Kerner, Mickey Quintrall 26th Annual National T&E Conference March 2nd 2010

DOE if Judicially Applied Can Aid in Test Planning Decisions

Verification Is this Really Test?

Verification Requirements

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- Why are they Needed?
  - Verification requirements specify the verification events needed to prove the satisfaction of the product requirements and help to define the verification process and environment
  - Verification requirements are necessary for at least two reasons:
    - Existence of verification requirements demonstrates verifiability of product requirements
    - Agreed-to verification requirements define the verification program by which the contractor shows that the product is what the customer contracted for.

- How Do you Write One?
- Answer the Following Questions:
  1. **Objective - What is the purpose of this verification?**
  2. **Method - What method do you need performed? What are the verification circumstances (e.g., laboratory, desk-top analysis, flight test)?**
  3. **Environment - What are the environmental conditions under which the item will be verified?**
  4. **Special Conditions (if necessary) - Are there any unique conditions (e.g., item configurations) necessary for the execution of the verification?**
  5. **Success Criteria - What results are to expected?**

Early Test Planning Starts with Requirements Development

Verification Requirement Example

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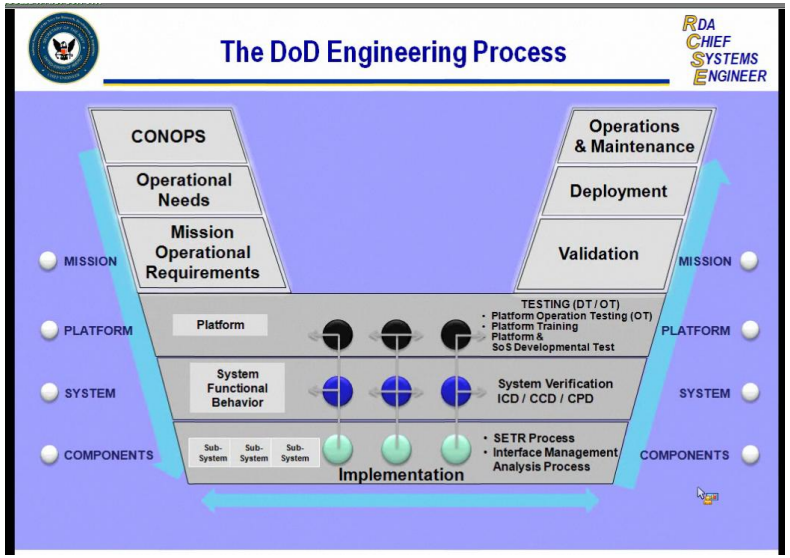
- **Requirement**
  - **The product shall provide a communications system (defined in Figure 1) capable of communicating with the recovery forces pre- and post- landing with both audio and digital communications.**

- **Verification Statement (1 of 3)**
  - **Prove that the product's communications system is capable of communicating with the ground command team by performing an laboratory within an integrated hardware/software environment. Testing will be conducted with the system operating under induced interference patterns as defined in Figure 7. Testing will show that the product can transmit and receive to standard ground recovery forces audio at frequencies represented by communications devices operating in the VHF/AM and S Band Frequency Bands. Voice communications will be measured using the Perceptual evaluation of speech quality (PESQ) P.862 defined method. Digital Communications will be measured by ensuring proper communications can be established by the receiving unit.**

Verification

- The verification program is:
  - Proof that the sponsor gets what they asked for
  - The collection of the data set which aids in the compliance assessment of a design requirement
  - The collection of data which aids in the assessment that A program has fulfilled its commitments
  - The main purposes of the test program



NDIA Systems Engineering Strategic Planning System Engineering Challenges in Naval System of Systems Ms. Helene Anderson
Office of ASN RDA CHSENG 8 December 2010 Miami, FL

Safe Testing Techniques

Safe Testing Considerations

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- Apply appropriate test methodology
  - Pyramid, bottoms up, agile, regression
- Establish prerequisites to safe testing (people and product)
  - Hazardous material handling, personnel considerations, test point / envelope expansion, etc.
- Understand and comply with policies which effect test program plan
  - Ex; test range requirements ,FAA policies, space qualification standards
- Understand constraints
  - Test limits, data limits, environmental conditions
- Establish test rules and entry / exit criteria
  - Know when you have completed the test, know when you have good data
- Establish controls
  - Security, flight line policies, configuration management, equipment handling, software

Safe and Effective Testing a Mandate of Every Test Program

Test Technique Examples

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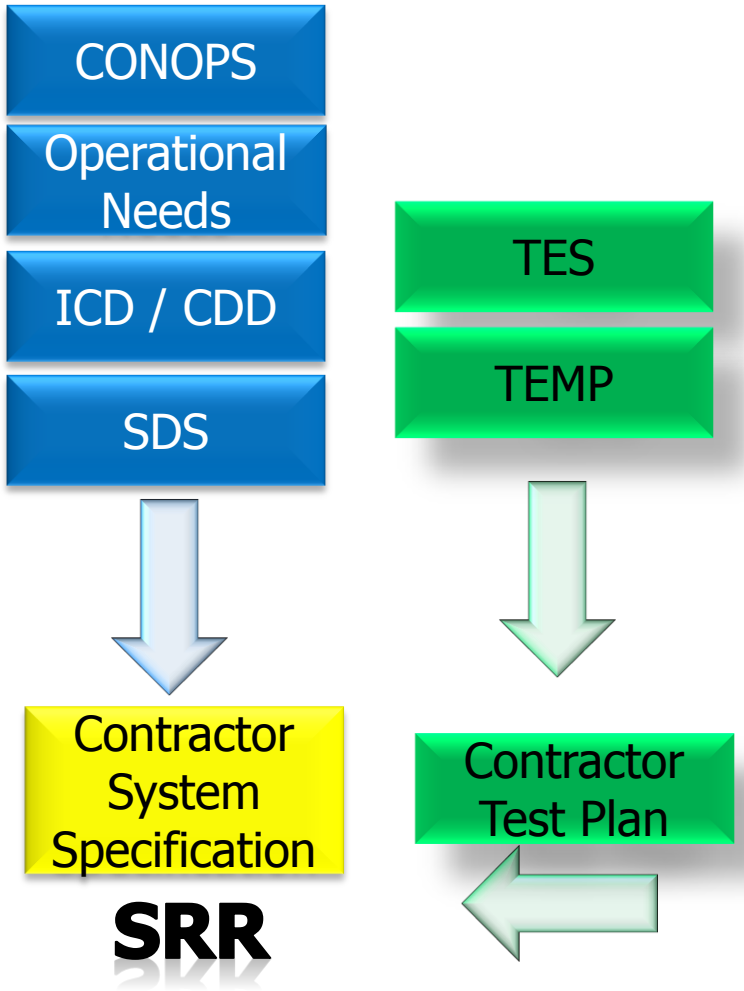
- Conduct a low speed taxi test
  - Evaluate Steering
    - Ensure aircraft travels down the runway (+/- 5 feet of center) at speeds up to and including 50 Knots.
  - Evaluate Communications
    - Ensure aircraft communications with ATC and Ground Station. Ensure no communication drop outs

A Controversy
Do we or don't we?

Testing Techniques Drives Product Requirements

- The Test Plan can and often does drive product requirements
  - Flight termination system
  - Instrumentation
  - Weight
  - Power
  - Space / volume
  - Communications protocol
  - Frequency allocations
  - Others?
- T&E does generate requirements
  - Identify requirements early to avoid design impacts
    - Don't be late to need



Test Tools

Test Planning Tools

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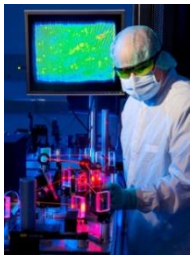
- **What is the T&E Test Planning Tool Kit?**

Planning	Test Design	Metrics	Assumptions
 Control A Control C Control V			
Complete Model Based Test Planning – Re-plan Test Planning Streamlining Costing / Scheduling Auto Test Plan Documentation	Event Planning Test Design Test Plan Validation	Test Program Work Flow / Metrics	Test Planning Assumption Corroboration Apply and maintain Lessons Learned

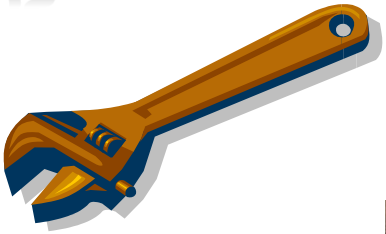
If you keep doing what you're doing
You'll keep getting what you're getting!

Test Planning –vs. – Test Techniques

FLYING TEST BEDS



LABORATORIES

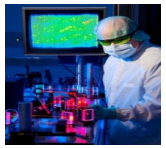


FLIGHT TEST

TEST RANGES

Test Planning Defines the Test Program Test Tools

Why These Techniques? – Some Examples



LABORATORIES

Off Nominal
Initial Integration
Interface Development
Problem Resolution
Functional Checkout

TEST RANGES

Installed Performance – Static
External Interface – Operational Fit Checks
Low Speed Dynamics
Initial System Control
External Communications

FLYING TEST BEDS

Dynamic Integration
Dynamic Functional Design Development
High Risk Safety Activities
TRL development in Operational Environment
Targeted Off-Nominal Tests

FLIGHT TEST

Operational Environment
Operational Performance

Pick the Right Tools for the Right Job

Test Resources

Test Tools - Resources

- Name your Resources – How Many - How Long

Engineers

Technicians

Chambers

Test Range

Test Stations

Instrumentation

Test Article

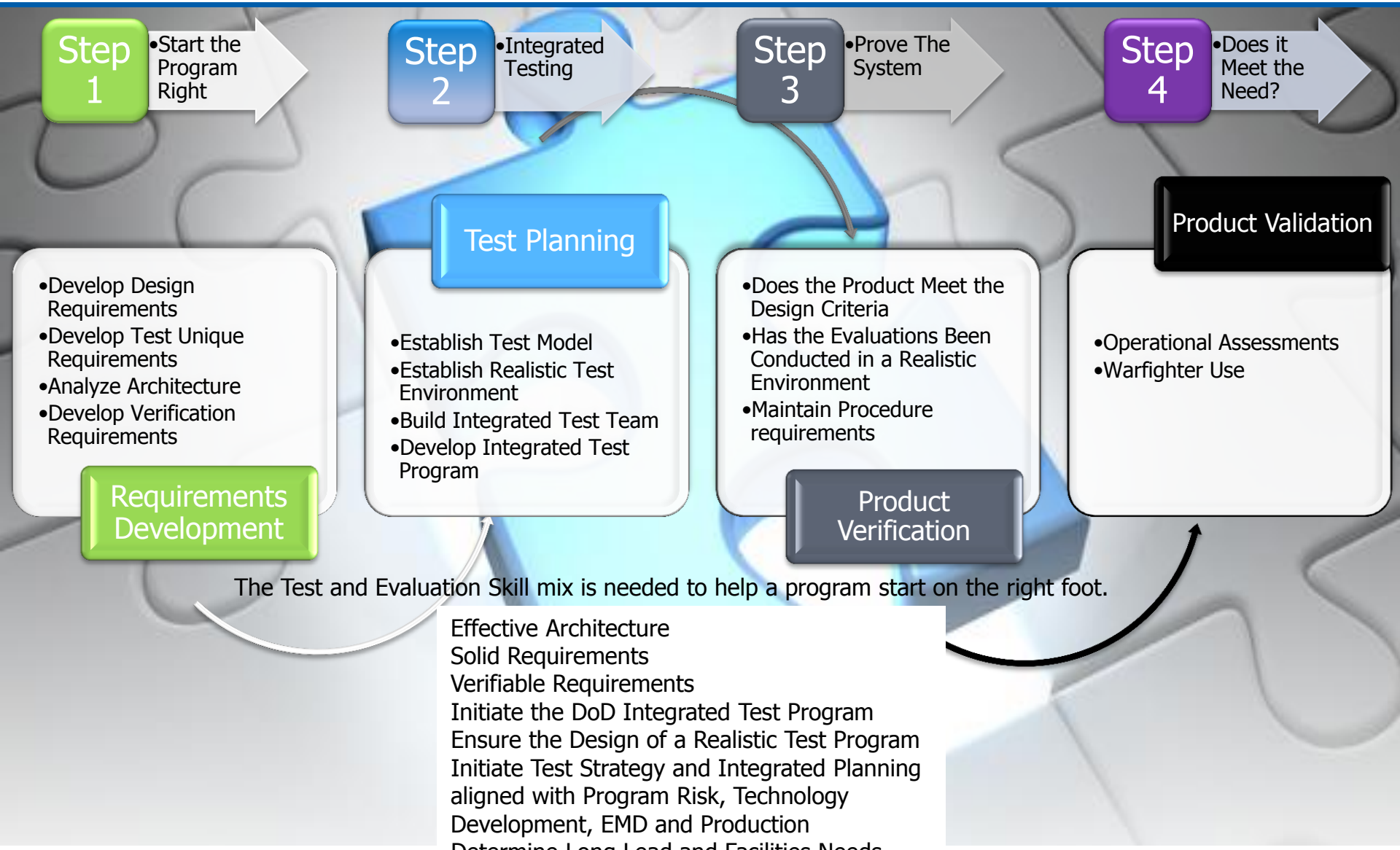
Test Tools - Resources

NORTHROP GRUMMAN

- Resources
  - Come in all varieties (facilities, equipment, people, tools)
  - Effect test execution
  - Have changing availability
  - Are required for test execution
  - Drive schedule
  - Drive cost
- Test Activities are Resource Dependant
  - There can be many resources required to execute a test
    - Think a SoS test activity
  - Resources can get lost in the change process

Test Planning Must Consider the Effect Of Resources at All Times

Putting it All Together



The Test and Evaluation Skill mix is needed to help a program start on the right foot.

Effective Architecture
Solid Requirements
Verifiable Requirements
Initiate the DoD Integrated Test Program
Ensure the Design of a Realistic Test Program
Initiate Test Strategy and Integrated Planning aligned with Program Risk, Technology Development, EMD and Production
Determine Long Lead and Facilities Needs

Keeping it All Straight

The Test Planning Variables

NORTHROP GRUMMAN

- Collaborative
- Integrated
- Traceable
- Schedule
- Tools
- Resources
- Risk
- Techniques
- Adaptable
- Dependencies

- Facilities
- Verification
- Lifecycle Activities
- MoEs, KPPs
- Realistic Environments
- Operationally Relevant
- Deliverable
- Managed
- Sequences

AND NOW YOU WANT TO KNOW THE PROGRAM IMPACT TO A CHANGE?

Help!!!!!!

Test Planning Tools – Minimum Requirements

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- Need
  - Collaborative
  - Handle traceability
  - Can model the test plan
  - Support test optimization
  - Connected to requirements and architecture
  - Supports the verification and test planning criteria
  - Can produce test planning artifacts
  - Can provide configuration management
  - Flexible to adapt to program needs
  - Can show the “big picture”
  - Can be used by all program personnel – all skill mixes

Let's Plan

NORTHROP GRUMMAN

- Review OV-1
- Review Requirements
  - Provide requirements assessment for requirements 2.5, 2.6, 2.7
  - Add verification requirement
  - Develop verification requirement for requirement 2.3.2
- Add traceability for requirement 2.3.2
- Develop test activities
  - Add flight test phase, (procedure development, test execution, report)
  - Connect appropriate verification requirements to test activities (2.3.1.C, procedure, execution, and report)
- Review Hierarchy
- Add Resources
- Connect flight test resources
- Optimize
  - Resources
  - Duration
- Produce Artifact
- Share Data

Table references are assumed to be developed correctly.

What We Covered

NORTHROP GRUMMAN

- Test Plan Values
- Test Plan Usages
- Test Plan Needs
- Test Plan Styles
- Design of experiments
- Test Plan Input Sources
- Verification
- Resources

- How to develop a test plan model
- How to optimize the plan
- How to produce an artifact
- How to advance the test planning science

Conclusions

NORTHROP GRUMMAN

- The DNA of T&E must Change
  - Need a complete lifecycle experience
- Test planning must be recognized as the requirements set for the test program
  - Document is not just a deliverable
  - Plan does not become extinct
- Test verification and planning techniques
  - Links the systems engineering team with the test team
  - Enables collaboration
  - Fosters communication
  - Supports development of early lifecycle products
- Test tools kit must be evolved
  - Model based test plans (know you have the right plan)
  - Physics based test event validation (know your plan is right)
  - Tools must be program sizable (big to little)
  - Tools must be connected to the requirements process
  - Tools must be collaborative

Testing is More Science Than Art.