Verification and Validation: Future Challenges and Benefits of Defence Style Testing

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Who Am I?

• Former RAAF C130H Navigator and Flight Tester
  – Aircraft Research and Development Unit (Avionics/Radar/Comms/Weapons)
  – Managed Defence Material Office Projects
• Nova Systems since 2007 (Consulting/Operations/Business Development)
• Defence Programs Supported (V&V) include:
  – Multi-Role Tanker Transport
  – Super Hornet
  – Joint Strike Fighter
  – C-17
  – Counter Improvised Explosive Devices (IEDs)
  – Satellite / Communications Systems
• **Current: Director – Rail Solutions**
  – UGL , Leightons, Downer, Sydney Trains, BTA, TfNSW
Why Test or Conduct V&V?

Experience    Knowledge    Independence
Relationship SM-2 v Rail/Transport

- **Current Challenges:**
  - ‘Sweating of Assets’ – legacy systems
  - Sub-system vs System (Integrated and Planned) Upgrades
  - Blending of old and new technologies
  - Certification
  - Safety Integrity Levels
  - Interoperability on Networks
  - S/W and H/W considerations
  - Supplier Integration – collaborative V&V and tools

- **Future Projects:**
  - Complexity and Systems Integration
  - Compatibility of mixed-systems
  - Technical and Operational Risks
  - Cost of testing
  - Fundamentals Inputs to Capability – Systems Approach
    - Organisation, personnel, collective training, major systems, supplies, facilities, support, command and management
Verification and Validation

- **Verification** confirmation system complies with specified requirements
  - Have you built the system right?

- **Validation** confirmation capability satisfies the end-user’s needs
  - Have you built the right system for the end-user?
Capability Life Cycle – V&V is an Integrated Process

- Experience
- Knowledge
- Independence

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V&V – Manages Risk

- Establish the Context
- Identify Risks
- Analyse Risks
- Evaluate Risks
- Treat Risks

Monitor and Review

Communicate and Consult

V&V

Use V&V to Determine Fit for Purpose

- Capability System Performance Evaluation
- Technology Evaluation
- Proposal Comparison
- Design Evaluation
- Contractual Compliance Verification
- End-user Validation
- Need Upgrade or New System
- Identify Solutions
- Select Solution
- Select Design
- Accept the System from the Contractor
- Release Operationally
V-Diagram
# Defence Testing Types - Summary

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<th>Developmental Testing</th>
<th>Acceptance Testing</th>
<th>Operational Testing</th>
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<tbody>
<tr>
<td><strong>Control</strong></td>
<td>Contractor</td>
<td>Contractor</td>
<td>Client Manage/Fund</td>
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<td>End-User Conduct</td>
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<tr>
<td><strong>Contractor Involvement</strong></td>
<td>Full</td>
<td>Full</td>
<td>Limited</td>
</tr>
<tr>
<td><strong>Client Involvement</strong></td>
<td>Observe</td>
<td>Witness (End User)</td>
<td>Conduct (End-User)</td>
</tr>
<tr>
<td><strong>Number of Tests</strong></td>
<td>One-to-One</td>
<td>One-to-One</td>
<td>Many-to-Many</td>
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<tr>
<td></td>
<td>One-to-Many</td>
<td></td>
<td></td>
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<tr>
<td><strong>Environment</strong></td>
<td>Controlled/Repeatable</td>
<td>Controlled/Repeatable</td>
<td>Realistic/Free Play</td>
</tr>
<tr>
<td><strong>Testers</strong></td>
<td>Contractor with system knowledge as required</td>
<td>Contractor/end users with System knowledge as required</td>
<td>Recently trained End-Users</td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td>As required to progress system/technical development</td>
<td>Verify Contract Specifications and resolve Critical Technical Parameters</td>
<td>Resolve Critical Operational Issues Validate Fit for Purpose</td>
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<td><strong>Types of Measurement</strong></td>
<td>Objective / Instrumented</td>
<td>Objective with Thresholds</td>
<td>Objective / Subjective (i.e. Rating Scales)</td>
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<tr>
<td><strong>Configuration of System Under Test</strong></td>
<td>System Development Baselines</td>
<td>System Product Baseline</td>
<td>Capability (all FICs) Effectiveness and Suitability</td>
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</table>
Requirements Definition and Management

- How the customer explained it
- How the Project Leader understood it
- How the Analyst designed it
- How the Programmer wrote it
- How the Business Consultant described it
- How the project was documented
- What operations installed
- How the customer was billed
- How it was supported
- What the customer really needed
Requirements Definition and Management

- ‘$#1@ in $#@ out’ process
- Investment upstream de-risks the downstream outcomes
- Capability Definition - Understand and Define the desired Capability
  => Solution Independent
- Build System(s) Specifications
- Construct V&V Programs with better clarity and definition
  => Control Costs and Risks
- Use Appropriate Processes and Tools – configuration/cost and scalability
- Improve Probability of Success
Context and Cost – Trade Offs V&V Methods

Test
Demonstration
Inspection
Analysis / Similarity

Confidence Level

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Example – BTA

- Project Engineering Maturity and Compliance Maturity were misaligned
- Requirements Management and Database
  - Management and communications tool
  - Dashboard to measure progress
  - Conflicting requirements were removed
- Test Early Test Once
  - Develop and capture methodology for sell-off and compliance
  - Use Developmental Testing where practicable
  - Compliance risk was known but reduced to an acceptable level
- Systems of Systems approach
  - Vehicle and subsystems at various stages of maturity
- Shift Risk to the left but remember validation is essential and client’s understanding will evolve as design evolves
Delivering the Outcomes for Rail (1)

• V&V is not just a tool
  – Needs to connect design to quality to safety to assurance to production to supportability etc

• Its all about risk management
  – Drive down compliance and delivery risk as far upstream as practicable

• Independent V&V
  – Adds value, transparency and objectivity
  – Can straddle supplier and client – collegiate approach
  – Generate efficiencies, deliver outcomes and lower cost/risk
Delivering the Outcomes for Rail (2)

- Defence ‘Best Practice’ and Standards can be applied and modified
  - Balance of rigour and risk
  - Gives a structure and discipline to RM and V&V process across the capability
  - Cost effective – *test the right things*
  - Often ‘supportability’ is the key to the delivering the ‘right system’ – we tend to focus on the bright and shiny (sexy) ‘platform’
  - Fundamental inputs to Capability – System of Systems