Don Wright - Introduction

- Validation Process Development Team (ADV Process)
 - Analysis Development Validation / Plans and Templates / Road to Lab to Math
 - Risk vs. Cost Balancing
- Vehicle Validation Manger (Vehicle Reliability / Durability)
- HVAC PTC Validation Manager (Heating Ventilation Air Conditioning Powertrain Cooling,)
- GM Process Owner, Validation Workflow & DRBTR (Design Review Based on Test Results)
- Wright Leadership Lean & Quality LLC
 - Teaching DRBTR through Reliatrain
 - IMS Expert Services (Expert Witness)
 - AMBE Engineering (Quality Consulting)
- Personal
 - BSME Automotive, General Motors Institute (Kettering), MSES RPI,
 - ASQ CQE, ASE Master Auto Technician, MACS 609 certified
 - Married, Live in Whitmore Lake with Nancy, 8 Grandchildren



VALIDATION IS SIMPLE!

(All you need is requirements and a plan)

Validation is SIMPLE! Prevent – Detect - Correct

- Good <u>Specifications</u>
- SMART <u>Plans</u>
 - <u>Specific / Measurable / Achievable / Relevant / Timely</u>
- Excellent Design Validation & Product Validation Execution!
- Excellent Follow Through (Finish, Document)

Happy Customers

Make it Look Easy! (M.I.L.E.)

Product Development Processes – Many / Similar



Product Development Process (Validation has a simple role)



Validation as Part of your PDP* *Product Development Process

- Validation OF Requirements
- Part / Math Development to Requirements
- Design Validation (DV)
- Product Validation (PV)
- Document and Produce (APQP, ADVP&R, DVPR)

Validation in The Context of your PDP

Product Development Process

- Sandbox / Synthesizing Requirements to meet a market need
- Requirements are VALIDATED (Validation OF Requirements)
- Design Selected based on bandwidth of requirements for this and future applications
- Design is Developed to meet requirements
- "P" Release
 - Production Intent Design is released in math that is intended to meet requirements)
- Validation OF the Design to the Requirements (DV)

Parts off Production Tools

- Validation OF Parts (the Design) made from production tools (PV)
 - Has the Production Implementation added variation / invalidated design?

REQUIREMENTS

(How do you know when you're done?)

It's All Based on Systems Engineering!

■ The BIG V



The Big V- More Complicated But....



Validation Process - Good Requirements

You can't validate if you don't have requirements!

These need to be:

- Measurable
- A reflection of the needs and desires of the customer
- Capable of being flowed down to lower levels of the system
- Capable of being validated with realistic resources
- Need to be defined relative to market:
 - 'Best in Class' to become World Leader?

Special Case: QRD Requirements <u>QRD Depends Upon...</u>

Requirements



Definition of Reliability

The probability of a product performing its intended function(s) in a manner which meets customer expectations, for a given period of time and/or miles under stated conditions.

This definition implies that:

- Reliability is a probabilistic measure
- Reliability requires an unambiguous criteria for "failure"
- Reliability is a function of the life of the item
- Reliability is a function of the conditions under which the item operates.

Validation Process – Reliability Requirements Answer These Questions

- What is the intended reliability evaluation point of the product? (At what point in time or miles?)
- What is the definition of a failure? How does it vary over time and/or miles?
- What is the maximum number of failures or rate of failure that is allowed?
- Under what operating conditions do the requirements apply?

Distinguishing Levels of Requirements Top Down Requirements Flow - VSC

Customer Requirement = Reliable Air Delivery & Comfort



The vehicle shall perform all intended functions for 150,000 miles or ten years with zero critical problems. Any problems discovered on GM Proving Grounds vehicle tests shall be addressed prior to the start of production.

The HVAC Module Expected life of the HVAC Subsystem, as a whole, shall be 150,000 miles or 10 years of vehicle operation...A/C requests is 30,000 with duration of 3600 hours, temp change requests is 36,700 with duration of 4940 hours....

The Actuator shall demonstrate a test reliability of R99 C50 per thermal and vibration test flow per GMW3172 (severe customer loads and environments)

PREVENT

(The easiest problem to solve is the one you never let happen) (Make It Look Easy / M.I.L.E.)

PREVENT!

Validation Deliverables: Requirements Lead to Plans



PREVENT

Validation Deliverables: Plans / Specs Supplier



PREVENT!

Expectations for Validation Engineers

- Build Efficient Validation Plans (ADV Plans) using the four allowable Validation Methods:
 - Analysis / Demonstration / Inspection / Test
- Be a Strong advocate for excellent Design Failure Mode Effects Analysis (DFMEA) and / or Design Review Based On Failure Modes (DRBFM)
 - FMEA is a Key input to Validation plans in high risk areas
 - DRBFM is key to risk management and efficient validation of incremental change
 - Good understanding of SAE J1739, and AIAG 4th Edition
 - Know the key elements of a quality DFMEA
 - Know where DFMEAs are stored, how to find DFMEAs
 - Know where to get assistance (people, website, etc.)
 - Actively participate in Customer / system interface DFMEAs
 - Actively participate in supplier DFMEA reviews
 - Use DFMEA to identify ways to strengthen the ADV plan

PREVENT!

Validation Engineer Role in DFMEA Detail



DETECT

Demonstrating Reliability / Proving Performance to Requirements

Detection: Big Idea, Bottom Up

DETECT!



- Components / Subsystems Validated
 - DV by IV MRD
 - Mostly at Suppliers' Labs!
- Vehicle Validated
 - Vehicle **Performance** Testing (VTS)
 - Bench / Vehicle Lab / Road
 - Vehicle Durability Testing
 - Vehicle General Durability. w/or w/o Corrosion
 - "1 life" durability < 1 life of system or component use.
 - Vehicle Corrotion => "10 yrs" Corrosion < 10 years in the field.

DETECT!

Distinguishing Levels of Requirements

Bottom Up Validation Flow – CSV

Customer Requirement = Reliable Air Delivery and Comfort



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The Actuator shall demonstrate a test reliability of R99 C50 per thermal and vibration test flow per GMW3172 (severe customer loads and environments)

DETECT!

Design Validation

<u>Design Validation</u>: The process of confirming through analyses, demonstrations, inspections, and/or tests that the product design meets its technical requirements (i.e., as specified in VTS, SSTS, CTS) <u>without</u> including the effects of manufacturing-induced variation. Variation will exist in the parts on 'test', but is not representative of the variation from the production process. Design validation can be done analytically or physically.

Note: If physical testing is used for design validation it is typically done on preprototype parts, but DV can also be conducted using production parts. Testing of production parts without sampling to reflect manufacturing variation is still DV.

DETECT!

Product Validation

<u>Product Validation</u>: The process of confirming through analyses, demonstrations, inspections and/or tests that the product design meets its technical requirements (i.e., as specified in VTS, SSTS, CTS) when <u>including</u> the effects of manufacturing variation.

To complete this validation in time to affect the Manufacturing Verification Builds, it may be necessary to simulate this variation in preproduction hardware or analyses. If hardware produced from production tools/equipment is used for Product Validation, then Sample Selection for Product Validation must follow GMN10066 Multi-Vari Sample Selection Procedure for Product Validation.

 Note: Product Validation is typically done on a subset of parts and a subset of technical requirements

CORRECT

Address All Issues / Read-Across / Lessons Learned

CORRECT!

Expectations relative to Problem Solving

- Customer Teams will write Issues on all vehicle test observations
 - Vehicle General Durability. w/or w/o Corrosion
- Validation Engineers write Issues on all DV / PV test issues
 - All Failures to meet Requirements!
 - Follow 7 Diamond (First four diamonds)
 - Process
 - Tools
 - Materials
 - Part Quality
- Validation EGM provide feedback on ALL test issues
- Validation EGM approves all Close Without Action
- Problem Solving is a 5-Step PROCESS!
 - Identify / Analyze / Plan / Implement / Evaluation (IAPIE)

Any Change Does one of 3 Things (and two of those are bad):

- 1. Fix what you were trying to Fix
- 2. NOT Fix what you were trying to Fix
- 3. Make new problems elsewhere in the design (make things worse)

Validation Expectations relative to Changes

- Validation Engineers are on Distribution for Changes
- All Validation Engineers are required to review changes for their assigned area and follow up.
- DRBFM Process (if followed) should make this a redundant check / audit.

Validation Deliverables: Status Monitoring



Key Points; Reviewing the Change

- Every fit-form-function change needs a DRBFM.
- If you weren't involved in the DRBFM, ask to see it.
 - Did the right people participate? (Was it truly a "good discussion"?)
 - Were all of the interfaces explored (part to part within your system plus interfaces and energy input / outputs from the part to other parts and subsystems from other SMTs?)
- Look at the Validation Statement (validation plan)
 - Do you agree that it is sufficient?
 - Is there new or repeated reliability testing required (DV or PV Level).
 - Is the plan to be done / closed before the change or is it a promise?

Key Points; Reviewing the Change

CHANGES!

- Finesse Points
 - Will the Change mean that previously completed tests need to be repeated?
 - Change after initial release / before Program Complete Date
 - Will the change mean that hardware in use for Dev / Val will need an update to the changed part?
 - Change after initial release / before program complete date
 - Is Regulatory compliance impacted (updating compliance tests, new test reports, compliance summaries?)
 - Change after Program Complete Date (Cost, Warranty, Continuous Improvement)

VALIDATION IS SIMPLE!

Prevent – Detect – Correct Good Specs – Good Plans – Great Execution

Validation Deliverables:

Workflow & Work Instructions vs. VDP timing



Validation is SIMPLE! Prevent – Detect - Correct

- Good <u>Requirements</u>
- Realistic / SMART <u>Plans</u>
- Excellent Design Validation & Product Validation Execution!
 - Validate the product to all requirements
- Excellent Follow Through (Finish, Document)

Happy Customers

Make it Look Easy! (M.I.L.E.)

Make It Look Easy

- Study the Game / Know the Playbook
- Train and Practice
- Plan and Anticipate / Prevent
- > On Time Start
- Execute / React / Get After It (TN1)
- Finish!
 - ✓ Celebrate on the run
 - ✓ Document
 - ✓ After Action (what went well what went wrong)
 - ✓ Start over and (make it better next time)

QUESTIONS?

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