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Translating End Product Verification Requirements Into Enabling Products

NDIA 32nd Annual National Test and Evaluation Conference

Marriott Mission Valley
8 March 2017

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Test Planning and Requirements – Aerospace Systems

Enabling products don't always enable T&E to meet the pace of need

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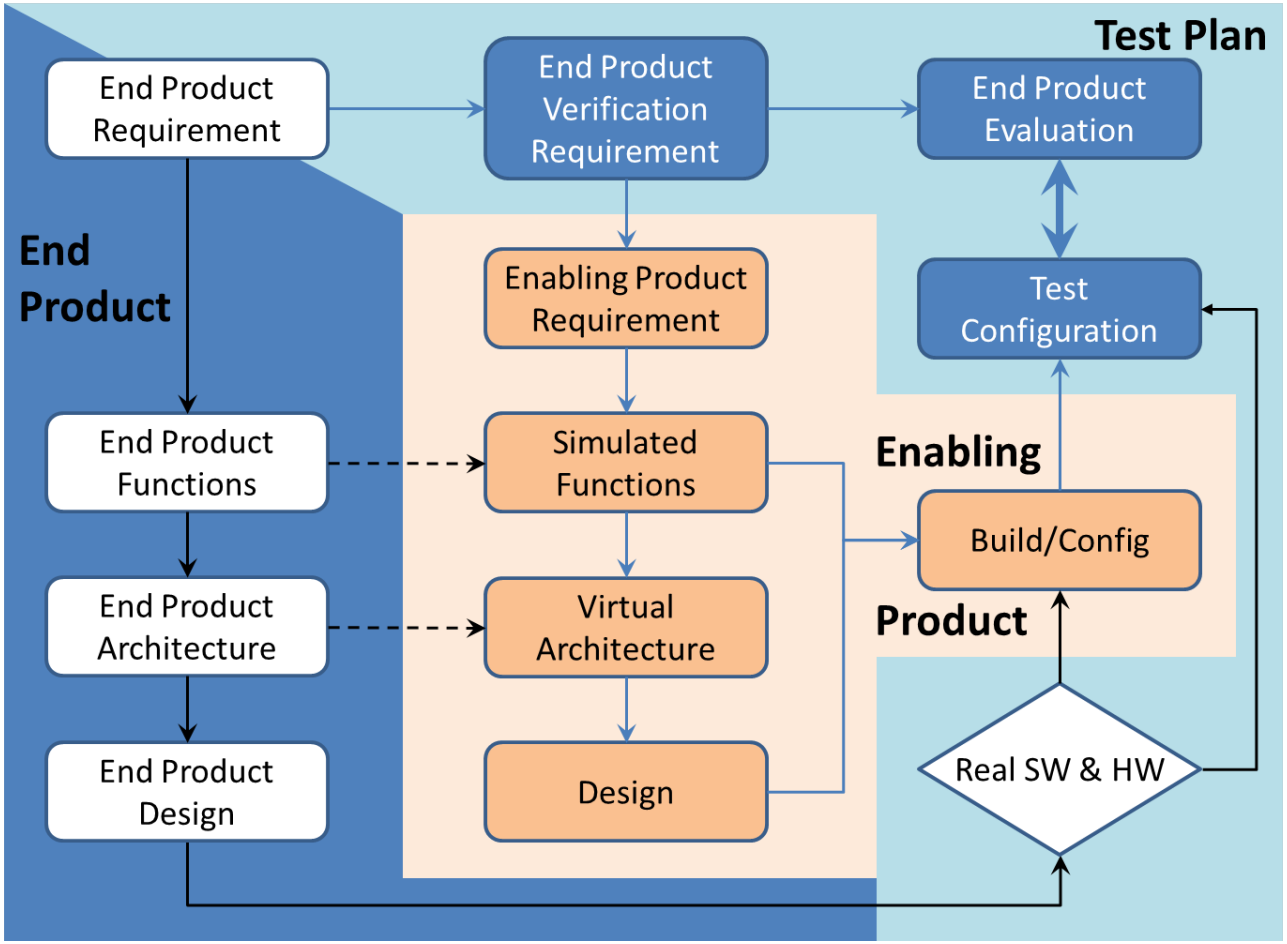
- Enabling product: "defined as those products required to enable the End Product to be developed, realized, tested, deployed, utilized, supported and retired." [1]
  - e.g., test beds, labs, virtual iron bird
- What often happens?
  - Enabling product shortfalls → it's good enough for some things, but I'm not as confident as I could be
- The Result?
  - Test program inadequate to fully evaluate end product prior to Initial Operating Capability (IOC) → delays from problems in IOC
  - Not enough data for concrete verification
- How do we get to good enabling products?

Enabling products *should* help T&E meet the pace of need

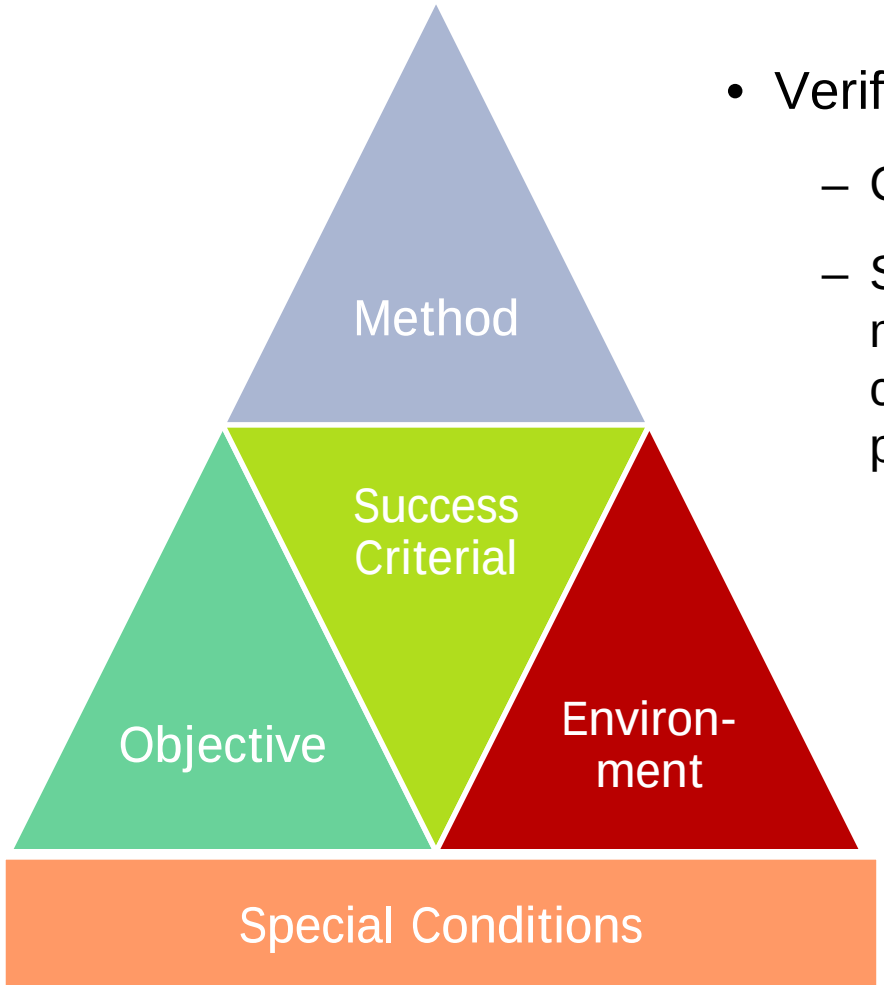
1. DAU SYS101 "Fundamentals of Systems Planning, Research, Development, and Engineering," Lesson 2.1.

A proposed roadmap



The map of connections between enabling and end products

It all starts here: The Verification Requirement



- Verification Requirement (VR):
  - Capture the intent of the requirement
  - Specifies the objective (breadth), methods, environment (depth), success criteria, and special conditions for product performance

→ **Success Criteria tell you what evidence the requirement owner really wants!**

- **So, what? T&E now has clear guidance as to what activities need planning**

Each VR informs T&E what data is needed for product verification

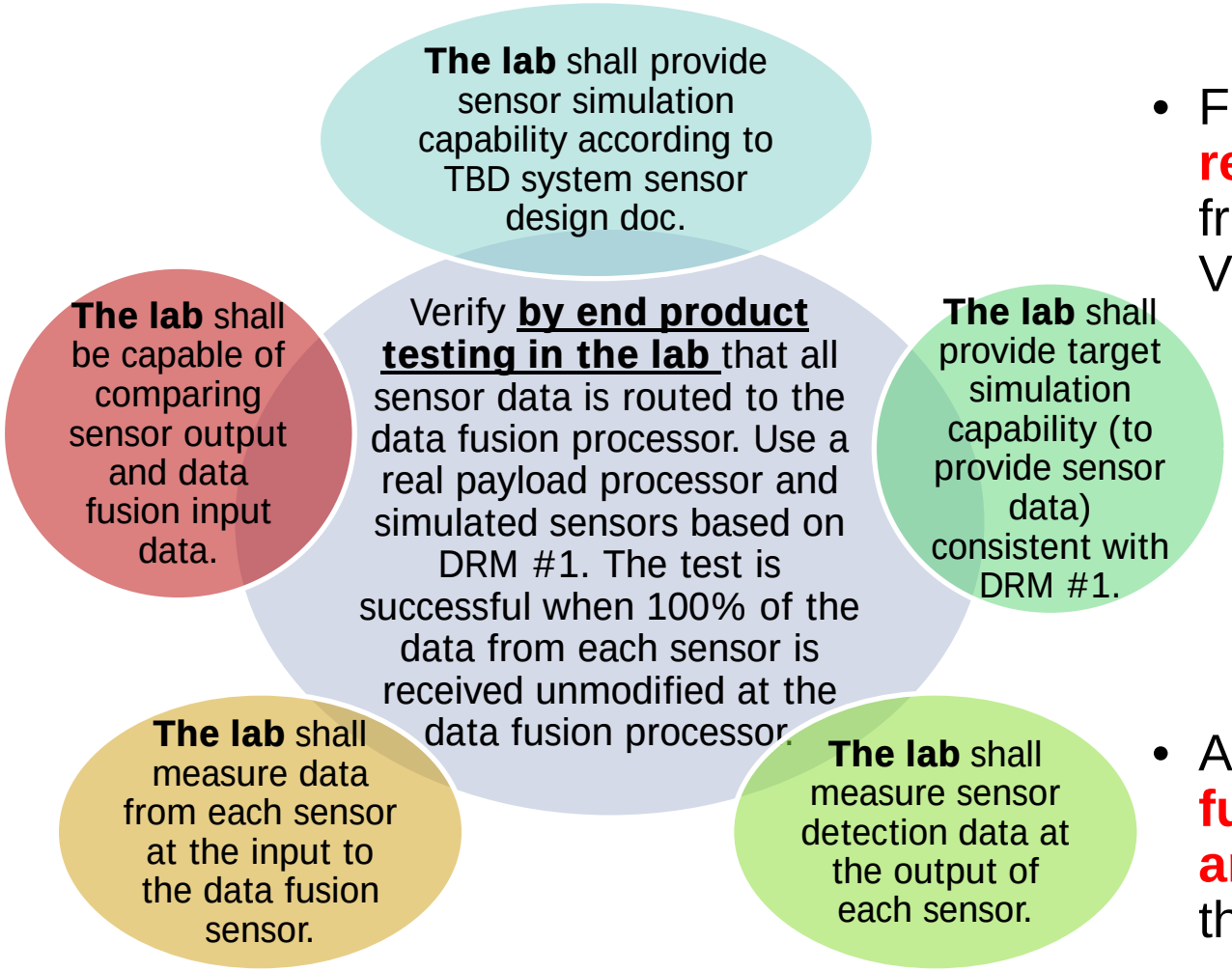
T&E Should ask for good VRs

- Verification requirements (VR) specify the verification events needed to prove the satisfaction of the product requirements and help to define the verification process and environment [1]
- VRs:
  - Capture the intent of the requirement
  - Specify the objective (breadth), methods, environment (depth), success criteria, and special conditions for product performance
  - → **They tell you what the requirement owner really wants!**
- So, what? VRs specify what enabling products must do in order to execute the VRs and prove the product

If you're not writing and using product VR's, you should!!

1. "A Day in the Life of a VR – Tutorial," 27th Annual National T&E Conference, 2011

End Product VR Yields Enabling Product Requirements

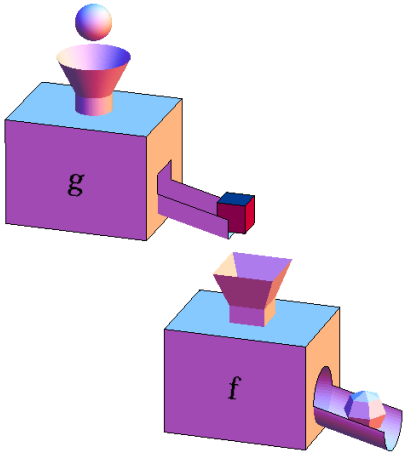


- Five lab **enabling requirements derived** from a single product VR
  - Physical lab to host at least portions of final product
  - Robust simulator(s)
  - Data analysis tools
  - Network analyzers
- And these result in **functions** and an **architecture** plan for the lab

DRM – Defense Reference Mission

End product VR's yield enabling product requirements

You want me to do what?!



Enabling Product **Functions**:

- What can be simulated?
- What must be real?
- What must a simulator do?

e.g., data flow across a bus, comms, landing gear raising/lowering, stress, structural loads, etc.?

- Interfaces and data exchanges?
- Test like you fly?

$$f(x)$$

Enabling product functions allow for robust T&E of end product

Frank Lloyd Wright's got nothing on me

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- Virtual Architecture: the build up of an enabling product environment that reflects maturity of end product being evaluated
  - Early workstations to evaluate software
  - Add test stations for hardware (HW)/software (SW) integration
  - Continue to build up your enabling product until you've got a full HW/SW capability, like an system integration lab, iron bird, mockup, prototype, etc.

- The virtual architecture represents what's there and what's not

The virtual architecture results in an enabling product build configuration

I want to be validated…so handle with care!

- The **Build Configuration** of the enabling product needs to be verified and validated

→ The enabling product must be treated like a product!

- The same level of rigor must be used to define and design
- Shall statements, VR's, design reviews, verification, AND validation!

T&E must not neglect their enabling products!

T&E Becomes All Things…

- In order to verify and validate the enabling product, Test must become all things (with help from these disciplines, of course!):
- Responsible Engineer: enabling product requirements and verification constructs
- System Engineer: overall enabling product life cycle, interfaces, V&V plans
- Test: evaluation of the enabling product

The hard work: how to prove and validate the enabling product

…But What Is The System Under Test (SUT)?

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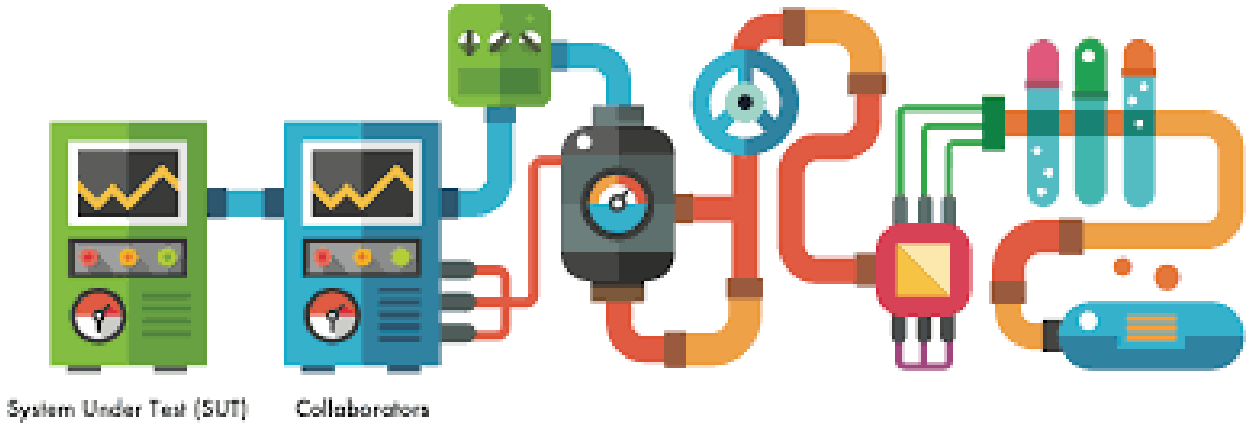
- The enabling product is the system under test during V&V of the enabling product
- Until the enabling product is through V&V, be extremely careful about using the end product to evaluate the enabling product
- How do I know when the enabling product is verified and validated? Ans. <u>When it meets its own VRs!</u>



The key? The enabling product is the SUT with its own VRs

Conclusions

- A roadmap to develop enabling products that enable T&E to meet the pace of need has been presented
- Enabling products should enable robust end product T&E so that schedule risks are reduced and T&E meets the pace of need
- The key? Verification Requirements
  - VR's drive both end product test planning and enabling product requirements
- The same design, development, and verification rigor applied to end products should be applied to enabling products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