

Introduction of Evolutional Verification and Validation Environment in JAXA

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1. Background



- Current Status of Software IV&V in JAXA
 - Number of IV&V-applied projects is increasing.
 - However IV&V resources are limited.

Cost Effectiveness

- IV&V environment is constructed according to development phases.
 - However synergetic IV&V effect between phases is

unrealized.

Coherent IV&V throughout development phases

- IV&V know-how is accumulated in documents.
 - IV&V manual, Checklists

Effective Utilization of IV&V know-how in past projects

2. Introduction of EVVE (1/2)

Evolutional <u>Verification and Validation Environment</u>



2. Introduction of EVVE (2/2)



Evolutional <u>Verification and Validation Environment</u>

Objectives

- To improve efficiency of IV&V
 - By reducing cost of building IV&V environment
 - i.e. Refining IV&V environment could be achieved by lower cost than rebuilding it at each development phases.

To improve effectiveness of IV&V

- By applying IV&V coherently throughout development phases
 - e.g. Consistency between S/W requirement and code could be verified through the refining process.

• To utilize IV&V know-how of past projects

- By accumulating IV&V know-how in the model and reusing it in the future projects
 - e.g. The component model and the related verification condition could be accumulated and reused if the similar component would be implemented in the future projects.

3. Approach (1/3)



Modeling

<u>Phase</u>	Requirement	Design	Code	Test
<u>Software</u> <u>Model</u>	UML model -state chart -acitivity diagram, etc.	Detailed model	Real code or Auto-generated code from model	Test cases based on requirement and operational scenario
<u>Peripheral</u> <u>Model</u>	Interface model based on ICD	Detailed model	-H/W emulator -Subsystem Simulator, etc.	H/W engineering model (if available)
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3. Approach (2/3)



Implementation

(1) In Early Phase (Static Model-based IV&V)



3. Approach (3/3)



• Implementation (2) In Later Phase (Dynamic Model-based IV&V)



4. Reuse of Models



- Transfer of know-how of IV&V between projects -

Reuse of Models

- Transfer modelling know-how for reuse development
 - Models included in IV&V environment of past projects could be reused or modified for reuse development
- Reuse of Verification conditions with Models
 - Transfer patterns of nonconformance in the past projects
 - Mistakable points in the model
 - Inspecting conditions for model checking
 - Test Scenarios (especially off-nominal cases) for simulation

5. Conclusion and Future Work



Conclusion

Effectiveness of EVVE

- <u>To improve efficiency</u> in building IV&V environment by refining the model as the development phase proceeds
- <u>To improve effectiveness</u> by performing IV&V coherently throughout development phases
- <u>To accumulate the IV&V know-how of past projects</u> in the model and reuse it in future projects

• Future Work

- To make prototype of EVVE and brush up the framework
 - Target: Dynamic verification of interfaces between components
- To collaborate with Model-based Development

To implement models provided by MBD into IV&V environment
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Thank you for your attention!

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