

# Software Architecture Evaluation Framework

## The Aerospace Corporation



# Software Architecture Evaluation

- Software architecture is a key part of many of our largest programs
  - *Primary carrier of system qualities, such as performance, modifiability, and security*
  - *Problems expensive to fix in time and money, especially if caught late*
- Project Goals
  - *Development of a framework of evaluation dimensions tailored for Space and Space –related programs*
  - *Document methodologies successfully used across acquisition phases*
  - *Provide guidance/training for teams conducting software architecture evaluation*
  - *Develop a tool that supports workflow for performing evaluations*
  - *Keep the emphasis on important features to evaluate, not evaluation process*
  - *Output of an evaluation :*
    - Identification of specific strengths and weaknesses
    - Actionable recommendations

# Why a Framework?

- Ensure comprehensive coverage
  - *Standardize assessment dimensions*
  - *Ensure attention to all key areas of importance*
  - *Guide partitioning of evaluation work*
  - *Avoid reinventing the wheel*
- Maintain Objectivity
  - *Make evaluation repeatable across teams and evaluations*
- Leverage Aerospace corporate experience
  - *Communicate software architecture expertise*
  - *Communicate an (increasing amount) of domain-specific guidance*
- Maintain Evaluation Focus
  - *Support drill-down to specific issues while maintaining “big picture” context*

**Provides guidance and structure for teams conducting software architecture evaluations**

# What is the Framework and How is it Applied?

- **At its Core:** A structured collection of 1000+ questions about an Space/Space -related program's software architecture
  - *Organized as follows:*
    - **Four** top-level categories
      - *Each category contains multiple dimensions (concerns)*
        - Each dimension has a set of evaluation questions
- Evaluators tailor framework for the target program and evaluation goals
  - *Evaluators select a subset of dimensions/questions*
  - *Questions are tailored for the target program/evaluation*
    - Can include deleting, modifying, and/or adding new questions
- Method agnostic and complementary with scenario based evaluations

# Framework: Categories and Dimensions

## Architecture Description

Architecture **Scope** Documentation  
 Architecture **Tradeoffs** Documentation  
 Use of **Viewpoints** and **Views**  
**Scope** of Documentation  
**Consistency** Across Views  
 Use of Description **Notations**  
 Organization and Traceability of Documentation

## Architectural Satisfaction of Functionality/Qualities

Architectural <b>Decisions</b> and <b>Tradeoffs</b> Reflect Program Drivers	<b>Openness</b> and Platform <b>independence</b>
<b>Flowdown</b> of Enterprise/System Architecture to Software Architecture	<b>External</b> Interfaces
<b>Allocation</b> of Requirements to Software Architecture	<b>Modularity</b> and <b>Layered</b> Architecture
Software Architecture <b>Consistency</b> with User Interface	<b>Scalability</b>
Software Architecture and Data Architecture are <b>Integrated</b>	<b>Flexibility</b>
COTS/GOTS <b>Appropriateness</b>	<b>Timeliness</b> and <b>Performance</b>
Reuse <b>Appropriateness</b>	<b>Reliability</b> and <b>Availability</b>
<b>Integration</b> of Reuse into Software Architecture	<b>Security</b> / Information Assurance
	<b>Manageability</b>
	Technology <b>Readiness</b>
	<b>Usability</b>
	<b>Safety</b>
	<b>Extendibility/Extensibility</b>
	<b>Survivability</b>

## Architecture Development/Evolution Methodology

Software Architecture **Process**  
**Personnel** and **Skill Mix**  
**Communication** and **Interaction**  
**Tools**

## Architecture Scope, Priorities, Tradeoffs

Architectural **Scope**  
 Software Quality **Attributes** and **Tradeoffs**

*Note: Many of these dimensions drill down into specific domains*

*These questions are tailored into program-specific questions to address key requirements and important characteristics the architecture needs to deliver*

# Example Questions

**Sample Requirement Addressed:**  
“The system shall be modifiable and flexible and expandable”

**Category:** “Arch. Satisfaction of Functionality/Qualities”

**Dimension:** “Modularity and Layered Architecture”

1. Is there a clear and reasonable separation of concerns (for example, application from infrastructure, user interface details from application behavior, hardware/operating system dependencies, middleware & commercial software dependencies)?
2. Are modular design principles (high cohesion among components, weak coupling & well-defined interfaces between components) incorporated to allow software to be functionally partitioned into scalable components?
3. What is the adopted layering model?
  - *Are there any layer violations? Are the risks of these violations and adequate mitigations plans identified?*
4. Is a layering model used consistently throughout the architecture (an example of inconsistency: some permit a component to use services at any lower layer, some permit use of services only at the next layer)?

***These questions are tailored into program-specific questions to address key requirements and important characteristics the architecture needs to deliver***

# Using the Framework in a Software Architecture Evaluation

- The framework does **not** define an evaluation process
  - *Though usage guidance is provided based on experience*
- Tailor the framework to account for:
  - *Different evaluation goals*
  - *Number of evaluators & their expertise levels*
  - *Specific domains to be investigated*
    - Space? Ground? Launch?
  - *Program lifecycle stage*
  - *Architectural information available*
    - Documents only? Access to architects and system experts?

# Tool Support: “Evalica” Evaluation Tool

## *Motivation*

- Organize a growing list of 1000+ questions
  - *With complex relationships:*
    - **Parent-child:** Parents set context for children
    - **Dimensions:** Each question in exactly one dimension (i.e., concern)
    - **Multi-domain:** Some questions pertain to one or more NSS-related domains
  - *Permit users to rapidly subset questions by multiple criteria*
- Provide a clearinghouse for evaluators to
  - *Tailor the questions to their evaluation*
  - *Capture answers and track the progress of an evaluation*
- Generic enough to be used for other types of evaluations

***Evalica provides tool support for evaluations***



# Tool Support: “Evalica” Evaluation Tool

## Demonstration

UNCLASSIFIED User: admin | DB: datica

### Evaluation Database

datica 1.0 build\_evalica\_01 [Advanced](#)

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**Current Evaluation** Architecture Evaluation [Rangifer Tarandus] **Dimension** Architecture Scope Documentation

[Change Questions that are Associated with this Evaluation](#)

**Response Summary**  3 /  1 /  3 /  0

Question	Last Updater	Rating	Status
Is there documentation of what should be included in the architecture and what should not?	Eric Dashofy	<input type="radio"/> ★★★★★	<input checked="" type="radio"/>
<b>Answer</b>	Yes, the documentation indicates that all components, connectors, and key interfaces are part of the architecture.		
<b>Assessment</b>	Key component behaviors should also be included.		
<b>Evidence Produced</b>	<a href="#">Software architecture description document</a> page 84.		
<b>Notes</b>			

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Question	Last Updater	Rating	Status
Is that documentation clearly written and expressed?	Eric Dashofy	<input type="radio"/> ★★★★★	<input checked="" type="radio"/>

***Evalica does not define an evaluation process***

***Evalica supports the evaluation processes***

# Generate Reports

UNCLASSIFIED

User: admin | DB: datica

## Evaluation Database

datica 1.0 build\_2011\_03\_12

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Filters  Search/Filter Clear Search/Filter

### Evaluation-Specific Options

**Current Evaluation:** Architecture Evaluation [Rangifer Tarandus]

- Show Only Evaluation-Relevant Questions
- Show Answers
- Show Ratings
- Show Assessments
- Show Evidence Produced
- Show Notes

Set Filters

## Generate Reports

This feature allows you to generate a variety of reports, including both questions and responses to those questions for the current evaluation. Set the filters using the controls above, submit, and click the link that appears below to download the report in HTML format.

[Click Here to Download Report For Current Filter Settings](#)

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