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

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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

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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

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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

Architecture Scope, Priorities, Tradeoffs

Architectural **Scope**

Software Quality **Attributes** and **Tradeoffs**

Architectural Satisfaction of Functionality/Qualities

Architectural **Decisions** and **Tradeoffs** Reflect Program Drivers

Flowdown of Enterprise/System Architecture to Software Architecture

Allocation of Requirements to Software Architecture

Software Architecture **Consistency** with User Interface

Software Architecture and Data Architecture are **Integrated**

COTS/GOTS **Appropriateness**

Reuse **Appropriateness**

Integration of Reuse into Software Architecture

Openness and Platform **independence**

External Interfaces

Modularity and **Layered** Architecture

Scalability

Flexibility

Timeliness and **Performance**

Reliability and **Availability**

Security / Information Assurance

Manageability

Technology **Readiness**

Usability

Safety

Extendibility/Extensibility

Survivability

Architecture Development/ Evolution Methodology

Software Architecture **Process**

Personnel and **Skill** Mix

Communication and **Interaction**

Tools

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.

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Example Questions

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.

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Using the Framework in a Software Architecture Evaluation

- The framework does **<u>not</u>** 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*
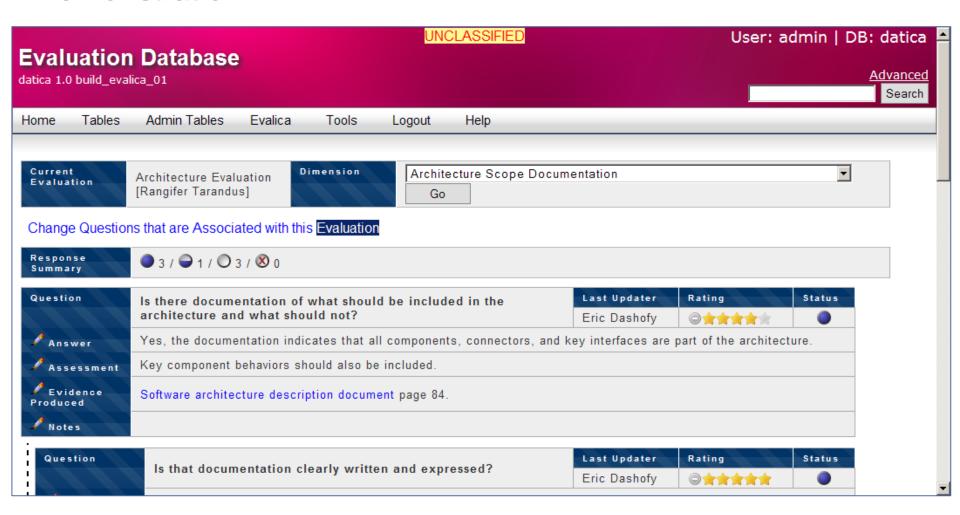   - Documents only? Access to architects and system experts?

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Tool Support: "Evalica" Evaluation Tool
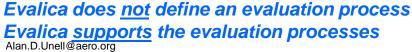*Motivation*

- 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*

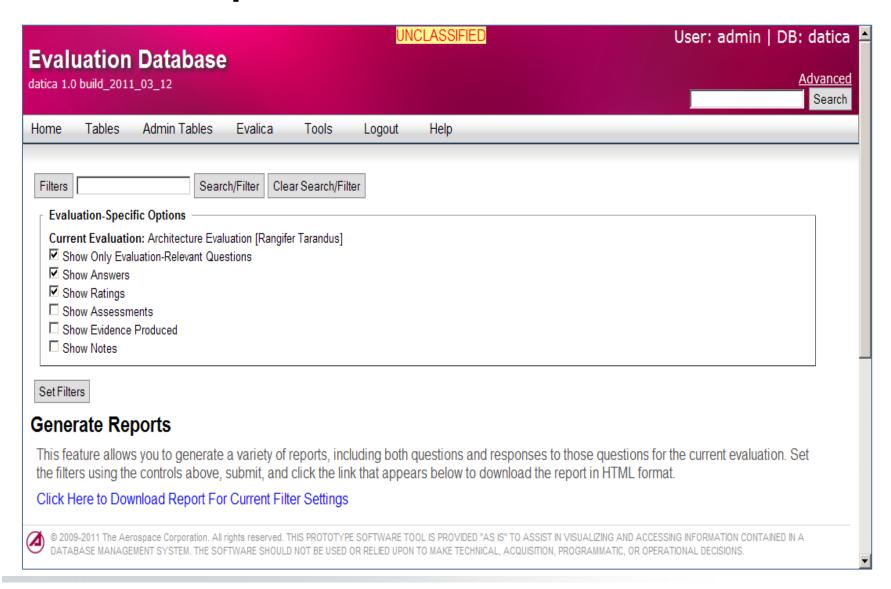- Generic enough to be used for other types of evaluations

Evalica provides tool support for evaluations

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Tool Support: "Evalica" Evaluation Tool
Demonstration

Evalica does __not__ define an evaluation process

Evalica __supports__ the evaluation processes

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Generate Reports

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