

Architectural Evaluation for Product Lines



A Report from GSAW 2000

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Architectural Evaluation

- A system's architecture represents some of the earliest design decisions about the system
 - The architecture makes some kinds of changes easy and others hard
 - The architecture represents or influences the system's "ilities"
- It is important to understand as much as possible about the architecture as early as possible
 - Architectural evaluation methods and tools can help with this

Product Line Architecture

- A product line may be defined as a group of products sharing a common, managed set of features that satisfy the needs of a selected market or mission area. [SEI]
- Defining a product line architecture (PLA) is key
- Evaluating a PLA poses special challenges
 - Need enough information about a PLA to be able to make good decisions about the instance systems
 - Many design decisions are deferred to the instance systems

Evaluating Product Line Architectures



- The state of the practice in architectural evaluation for product lines is still evolving
- A key question:

How are the evaluation requirements for a product line architecture different from those for the architecture of a single system?

Architectural Evaluation for Product Lines

- To identify some of these requirements, a breakout session was held on Architectural Evaluation for Product Lines
 - At the Ground System Architectures Workshop (GSAW2000), The Aerospace Corporation, February 23-25, 2000
- Presenters and participants discussed architectural evaluation, focusing on product line architectures

Issue Categories



- The issues raised were allocated to loosely defined categories:
 - Features - Things that can be assessed
 - Assessment - What you do to evaluate features
 - Quality - Results of assessment
 - Process - Development process
 - Evolution

Features Questions: Architectures




- How do you represent an architecture so that you can better understand its characteristics (e.g., behavioral, performance, optimization, composition)?
 - What notations do you use to describe it?
 - What parameters of an architecture do you model?
- How do you know something is a product line?
- What (if any) are the interactions between the architecture of a product line and the architecture of any sub-product line?

Features Questions: Variation Points



- How do you specify, define, represent variation points?
 - So that you can better understand their behavioral, performance, optimization, composition, etc. characteristics
- What is the granularity of variation points (e.g., component level, subsystem level)?
- What is the nature of the variation (i.e., different implementations or different functionality)?

Features Questions: Components and Connectors



- How do you specify the behavior of a connector or component to capture all of the assumptions in a given architecture?
- What are the issues regarding domain independence and domain dependence both for components and for connectors?

Assessment Questions

- How do you evaluate a product line architecture?
 - What are the criteria for assessing goodness?
 - How do assessment methods change when you evaluate PL architectures versus product architectures?
- What forms of evaluations are there?
 - Some examples: modeling, analysis, prototyping, questions, checklists, metrics, cost estimation

More Assessment Questions



- How do you determine whether your architecture can support a product line?
- How do you infer properties of a system from the combination of an architecture and a set of components (or from potential changes to the components)?
- How do you validate the results of different assessment approaches?
 - How do you fuse the results?

Quality Questions

- What is a good architecture (depends on context and perspective)?
- What are the criteria (standards) you use to determine whether the architecture is appropriate or not?
- How do you interpret evaluation results according to different stakeholders' perspectives?

Development Process Questions

- What is the relationship between the PLA and how you intend to produce the products?
 - e.g., Generate, compose, instantiate, build, configure
- How would you use architectural evaluations as part of an iterative design process?
- What kind of tool support is there for developing PL architectures?
 - e.g., Tools for understanding the impact of variation points
- How do you manage variation points?
 - How many is too many, is there a right number?

Evolution Questions



- How do you manage evolution of an architecture and its components?
 - How do you accommodate new requirements and avoid architectural drift?
- How do you build in enhancements during sustainment, not just simple bug fixes?
- How do you track architectural conformance during development and evolution?
 - How important is it?

Breakout Session Conclusions



- Still many unknowns, but many organizations are making inroads
 - Academia, industry, and government
- Consensus on some questions, others are more contentious
 - Some questions seem to have been resolved, at least in specific domains

Plans



- Schedule another breakout group at GSAW2001 to assess progress
- Discuss some of these issues at workshop on Product Lines for Command-and-Control Ground Systems
 - At SEI First International Software Product Line Conference, August 28-31, 2000
 - More information at <http://www.sei.cmu.edu/plp/conf/SPLC.html>