

Zhao Li¹, Roland Weiss², and Karen Smiley¹

1. ABB ISS US Corp. Research Center, 2. ABB S.p.A –Power Systems Division, Italy

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Scaling Architecture Evaluations Within Real-World Constraints

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Agenda

- **Background**
- State of the Practice
- Nature of Software Architecture Evaluation
- Module Based Architecture Evaluation
- Test Cases
- Conclusions
- Contact

Software Architecture Evaluation Becomes Important in Industry

- Industrial software products and systems become increasingly complex:
 - Externally (network based, large-scale, and distributed)
 - Internally (concurrent and multi-threaded)
- Identifying issues and risks early in the development cycle becomes more important
- Development of industry-friendly evaluation approaches attracts more research efforts

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State of the Practice

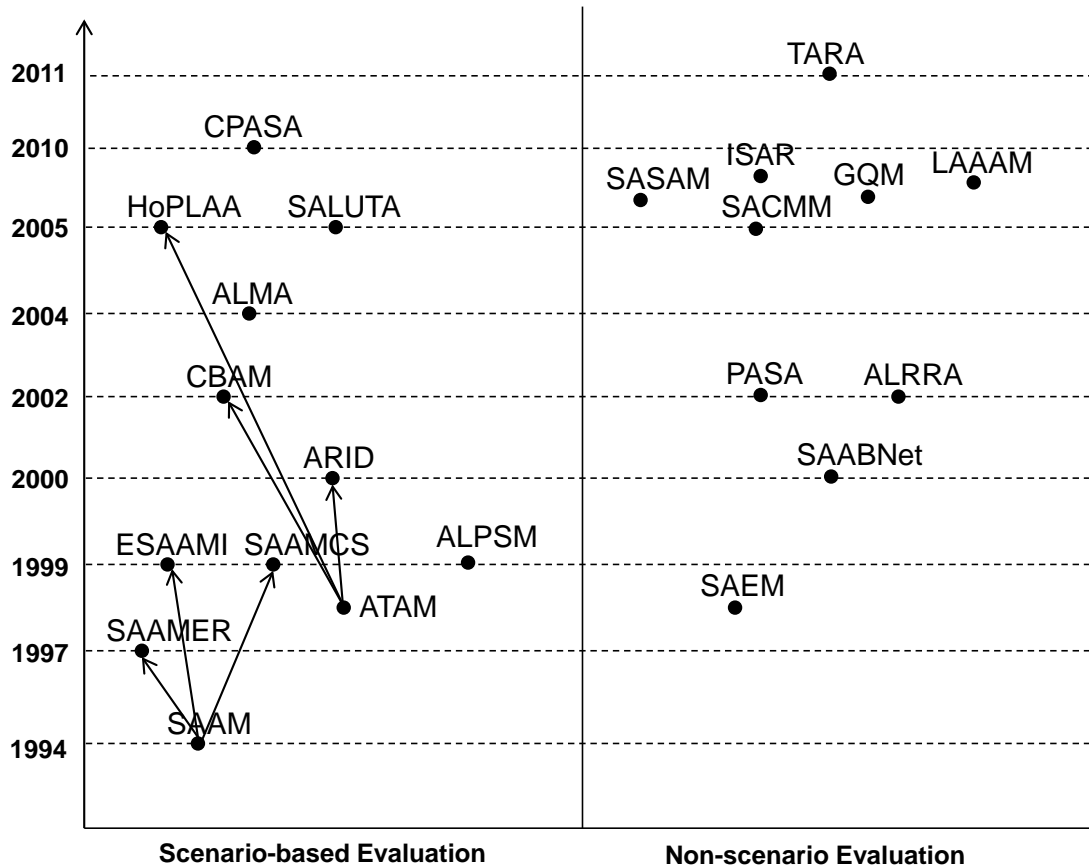
- **Industry**

- Informal procedures predominate
- Strong reliance on experience of individual evaluators
- Hard to predict evaluation accuracy based on budgets
- Industrial constraints (e.g., geographical factors, time pressure)

- **Academia**

- Hot research topic since 1994
- Plethora of research results
- Relatively few real applications industry-wide have benefited from research results

Gaps to Practical Industry Application

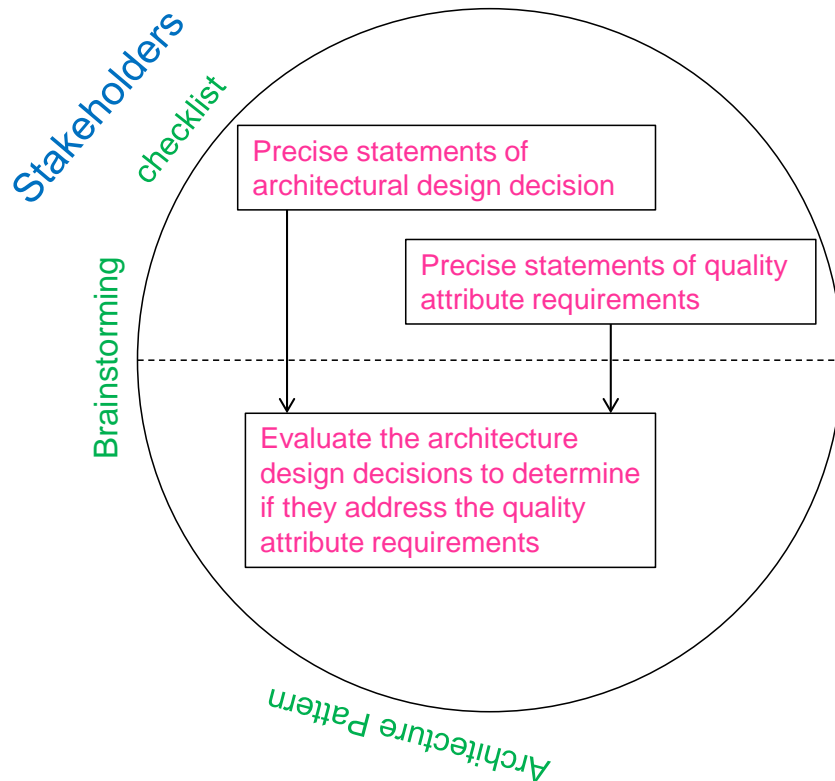


- Most methods only address part of issues triggered by evaluation
- Few methods in different categories share benefits: choosing evaluation methods in one category most likely miss the benefits unique to methods in other categories
- Perceived high costs and efforts

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Nature of Software Architecture Evaluation



Evaluators?? →

An evaluator needs a formal procedure to organize everything.

- A SAE is a procedure to deal with stakeholders, business factors, experience and knowledge via a series of methods (e.g., workshop, scenarios and others).
- A well designed evaluation consists of a good selection of methods, whose contributions are maximized to meet the needs of the project under constraints of budget.

Yardstick for an Ideal Industrial-based Architecture Evaluation Methodology

- Has a unified framework and formal procedure
- Maximally absorbs and utilizes the merits of methods already defined
- Opens to incorporate advantages of methods defined in the future
- Predicts the accuracy of evaluation results based on provided budgets
- Enables allocation of the right resources on the right evaluation activities to optimize results

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The Module-based Software Architecture Evaluation Methodology

- Standardizes methods and tools into modules
 - Each module has input, output, and cost estimation
 - Modules can be extracted from SAE methods
 - in the past or in the future
 - in academia or in industry
 - Modules are designed for industry
- Provides guidance on choosing modules within each module category

Module Library

	Basic Evaluation Modules	Optional Evaluation Modules
Data Preparation	<p>Collect data based on evaluator's subjective judgment</p>	<p>Verifying collected data against source code (TARA)</p> <p>Quality attributes characterizations (ATAM)</p> <p>Face to face workshop</p> <p>Individual face to face interview</p> <p>Web-based forum</p> <p>Individual phone interview</p> <p>QAW</p>
Evaluation	<p>Evaluating based on evaluator's mind model</p>	<p>Existing knowledge on software architecture</p> <p>Software Architecture Pattern</p> <p>Prototype</p> <p>Documented test results</p>
Verification	<p>Verifying based on evaluator's mind model</p>	<p>Face to face workshop with stakeholder</p> <p>Web-based forum with stakeholder</p>

Key: TARA Tiny Architecture Review Approach, IEEE/IFIP 2011

Examples of Data Gathering Modules

Modules	Input	Output	Cost (PD: person day)	Quality
Workshop 1. face to face, 2. video conf.	1. Func+QA 2. Arch. docs	1. Elaborated func + non-func 2. Commented arch. Docs 3. a prioritized list of QA	70 PD (Standard) 32 PD (Brief)	Better
Web-based forum	1. Func+QA 2. Arch doc	1. Elaborated func + QA req. 2. commented arch doc 3. a prioritized list of QA	7 PD (standard) 3~4 PD (Brief)	Good
Individual interview 1. Face to face 2. Video conf. 3. Tele conference	Questions on func + QA	answers for questions	2 PD (Standard) 1 PD (Brief)	ok

Workshop:

Pros:

- Face to face communication

Cons:

- Geographic issue
- Political issue
- Time pressure

Web-based forum:

Pros:

- Flexible to the schedule of participants
- Adapt to the geographic location of participants
- Anonymous of participants minimize the political issues

Cons

- Lose the chances of face to face discussion

Steps of Module Based Architecture Evaluation

Main steps of the module-based evaluation

1. Check the quality of the architecture documents	Ensure the arch. Docs are availability and have adequate quality, Iterate if necessary
2. Instantiate the evaluation methodology	Select evaluation modules based on budget and objectives. Iterate step 2 if necessary
3. Build the evaluation team	Inputs of step1 and 2, required competency, budget, availability of resources
4. Prioritize the quality attributes	Collect the prioritized quality attributes from stakeholders, iterate 4 if necessary
5. Analyze the architecture	Develop the quality attributes into scenarios and analyze them against architecture design decisions
6. Verify the evaluation results with stakeholders	iterate step 5 and 6, if necessary
7. Present results	Present the evaluation results to stakeholder

Key:

Step 1 ~ 4 belong to data collection

Step 5 is associated with evaluation

Step 6 ~ 7 is link to verification

The modules in corresponding categories in the module lib can be applied to each step

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Test Case 1

- Background
 - Software Architecture Design Documents are in good shape
 - Pros: The architecture design has been prototyped
 - Cons: Only limit budget: 5 person days
- Evaluation process (**PD: person day**)
 - Check the quality of architecture docs (0.5 PD)
 - Formulate evaluation method (0.5 PD)
 - Phone interview + prototype verification
 - Build Evaluation Team (0.2 day)
 - Expertise and availability
 - Verify and prioritize architecture requirements with BU product manager (0.3 days)
 - Performance + scalability
 - Install and run through prototype with test cases (3.5 PD)
 - Report: tele-conf. with CR project lead + BU PM (0.5 PD)
- Utilize right resources on right work under constraints

Test Case 2

- Background
 - Cons
 - Software Architecture Design Documents not in good shape, performance and scalability are misinterpreted
 - 2 PW budget (PW, Person Week)
 - Architect, evaluator, BU product manager are in different location (geographic distributed)
 - Evaluation time, Dec 10 ~ Dec 30 (holiday season), email a major communication method
 - Pros
 - Resources are available
- Evaluation process
 - Check the quality requirements, bring an requirement expert on board, iteratively improve the quality of architecture doc. (2 PD)
 - Define the evaluation module: web-based forum, individual phone interview, tele-conference (0.5 PD)
 - Select best resources to mitigate the cons
 - Requirement SME
 - Domain architect SME
 - Launch web-based forum to kick off the evaluation
 - Misinterpretations between BU PM and Architects on some key concepts -> Stop the evaluation, raise this issue

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Results and Lessons Learned

- Effectively maintain a unified evaluation framework, pre-allocating time to each individual phase: data preparation, evaluation, and verification based on module selection
- Easily adapt to diversified constraints
- Break through the isolation of different types evaluation methods
- Naturally melt various software architecture artifacts into evaluation
- Efficiently utilize various resource and constrains to maximize the evaluation results

Summary and Future Work

- Key of the Module-based Evaluation
 - Standardize the events and activities from existing evaluation methods (past and future) into standard modules
 - Selectively reuse the defined module under an evaluation framework based on the evaluation budget and required quality
- Future work:
 - Adding and tuning modules
 - Executing more evaluations
 - Draw interest from other practitioners

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- Zhao Li
 - Architect,
 - ABB US Corp. Research Center
 - Zhao.li@us.abb.com

- Roland Wesis
 - Global Project Manager S+ Operations
 - ABB S.p.A – Power System Division
 - Roland.weiss@it.abb.com

- Karen Smiley
 - Principle R&D Engineer
 - ABB US Corp. Research Center
 - Karen.smiley@us.abb.com

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