Architecture Evaluation

Why Evaluate?

- By the designer to inform decision making.
- By peers to inform decision making or to allow progression to later stages in the process.
- External evaluation when the architecture is closer to being complete.

Evaluation by Designer

- The consequences of the decision regulate how much effort to put into the process – more importance means more effort in evaluation.
- Try to use iterative approaches that get deeper in order to eliminate unpromising alternatives early.
- Don’t strive for perfection, good enough for the context is usually enough.

Peer Evaluation

- Fix on the QAs to consider as part of the review – may be determined by the process or the business case.
- The architect presents the architecture to the reviewers – questions are for information.
- The review is driven by the relevant scenarios – the architect talks the review team through a scenario demonstrating the architecture meets the requirements captured in the scenario.
- The outcome is a list of potential issues with actions: fix, mitigate, tolerate, …

External Evaluation

- Means to bring in additional expertise.
- May represent some stakeholder interests.
- More expensive and difficult to organise so this will often correspond to some major hurdle in the process.

Contextual Factors

- What artifacts are available?
- Who sees the results of the review?
- Who performs the evaluation?
- Which stakeholders will participate?
- How does the evaluation relate to business goals of the system?

Example: ATAM – The Architecture Tradeoff Analysis Method

- Designed by the Software Engineering Institute: http://resources.sei.cmu.edu/library/asset-view.cfm?assetid=5177
- Designed to be usable where:
  - Evaluators are not expert in the architecture
  - Evaluators need not be familiar with the business goals.
  - The system need not be fully developed
  - There may be large numbers of stakeholders

Participants in ATM

- **The evaluation team:** 3-5 people with designated roles (people may have multiple roles). Team members should be seen to be neutral with respect to the project.
- **Project decision takers:** manager of the project, funder of the project, main architect
- **Architecture stakeholders:** developers, testers, integrators, maintainers, performance engineers, …

The Evaluation Team

Role	Responsibilities
Team Leader	Sets up the evaluation; coordinates with client, making sure client's needs are met; establishes evaluation contract; forms evaluation team; sees that final report is produced and delivered (although the writing may be delegated)
Evaluation Leader	Runs evaluation; facilitates elicitation of scenarios; administers scenario selection/prioritization process; facilitates evaluation of scenarios against architecture; facilitates on-site analysis
Scenario Scribe	Writes scenarios on flipchart or whiteboard during scenario elicitation; captures agreed-on wording of each scenario, halting discussion until exact wording is captured
Proceedings Scribe	Captures proceedings in electronic form on laptop or workstation: raw scenarios, issue(s) that motivate each scenario (often lost in the wording of the scenario itself), and resolution of each scenario when applied to architecture(s); also generates a printed list of adopted scenarios for handout to all participants
Questioner	Raises issues of architectural interest, usually related to the quality attributes in which he or she has expertise

ATAM Outputs

- **Concise presentation of the architecture** – needs to be presentable in around one hour.
- **Articulation of the business goals –** clearly communicated to all participants
- **Prioritized QA requirements expressed as scenarios –** testable QA requirements.
- **Risks and non-risks –** architecture decision that carries risks (or not).
- **Risk themes –** attempt to identify systemic risk by grouping risks into themes.
- **Mapping of Architecture Decisions to QA requirements –** motivating architecture decisions by QA requirements
- **Identified sensitivity and tradeoff decisions –** critical decisions that have significant impact on QA requirements.

Phases of ATAM

Phase	Activity	Participants	Typical Duration
0	Partnership and preparation	Evaluation team leadership and key project decision makers	Proceeds informally as required, perhaps over a few weeks
1	Evaluation	Evaluation team and project decision makers	1–2 days followed by a hiatus of 1–3 weeks
2	Evaluation (continued)	Evaluation team, project decision makers, and stakeholders	2 days
3	Follow-up	Evaluation team and evaluation client	1 week

Phases of ATAM

- **Phase 0:** Getting the schedule, agendas and list of stakeholders prepared and preparing necessary documents and presentations and gettting documents to the evaluation team
- **Phase 1 :** Evaluation team + decision makers – information gathering and clarification.
- **Phase 2:** Stakeholders join in the process.
- **Phase 3:** Follow up.

Evaluation Phase Steps

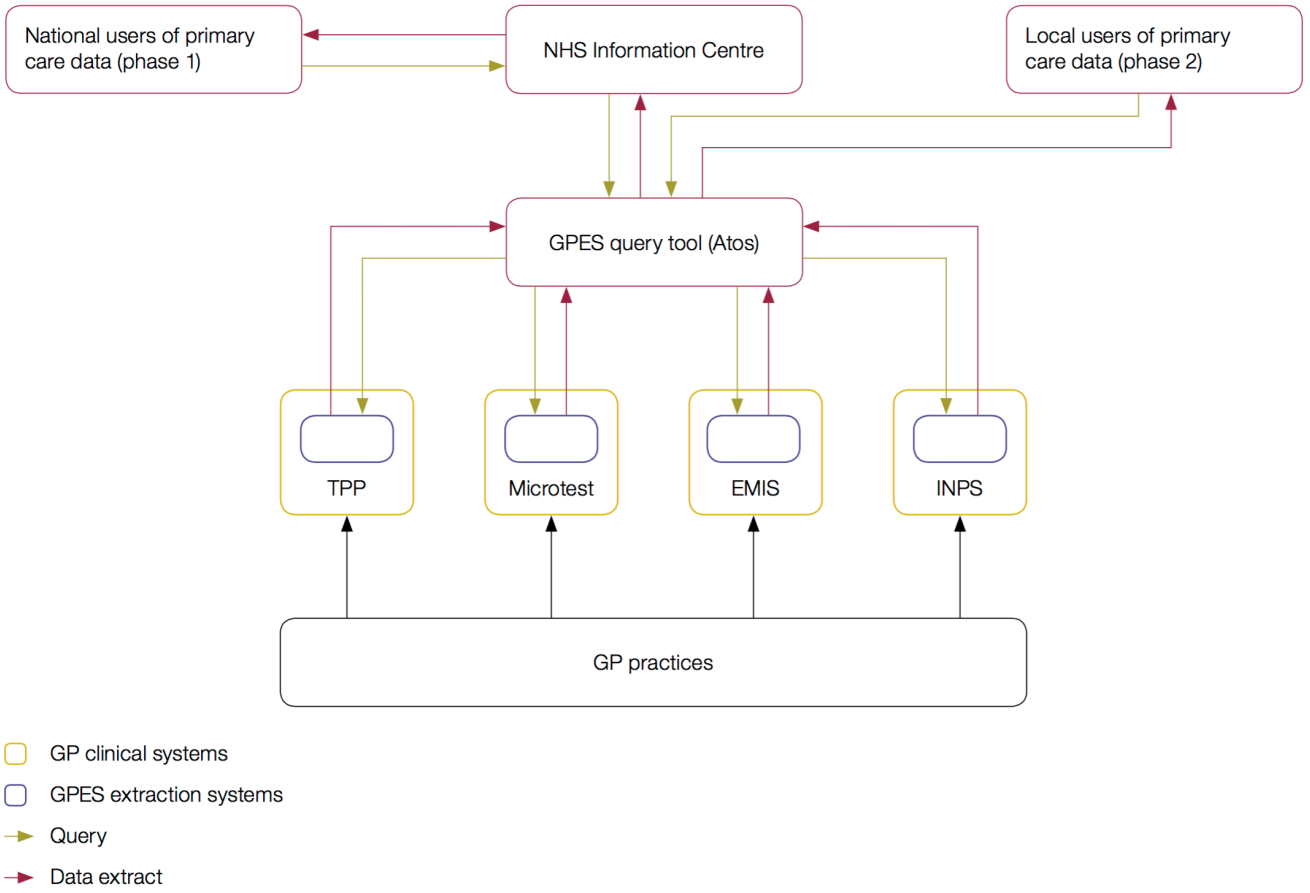
1. **Presentation of the ATAM approach –** remind participants of the approach
2. **Business drivers presentation –** functions; constraints; business goals; major stakeholders; architectural drivers
3. **Architecture presentation:**
   - Context for the system
   - Static modular view
   - Component and connector view
   - Deployment view
   - Main QA requirements and how the architecture addresses them:
     - What has been reused
     - Trace of key use cases
     - Trace of key change scenarios
     - Main issues/risks driving architectural change

Evaluation Phase Steps

4. **Identify architectural approaches –** create a catalogue of patterns and tactics used in the architecture.
5. **Generate Quality Attribute Utility Tree -** this is an approach to identifying architecturally significant requirements (ASR) by looking through the QAs – identifying particular aspects of the QA that are relevant and any requirements related to that aspect of the QA. Each ASR is ranked High, Medium or Low in importance.
6. **Analyze architectural approaches –** look at the most important QA requirement scenarios as identified at stage 5 and probe how the architecture meets the QA scenario.

- **At this point the first analysis phase is complete**

Recall the GPES Structure



Source: National Audit Office, based on information in the NHS IC GPES business cases

Example: ATAM for GPES

- Consider some aspects of ATAM for GPES:

2. Business drivers: the need to be able to meet a large number of varying requests from varied stakeholders with good response time.
3. Present the static view, component view and deployment view if available: trace through how a request for a new extraction of data would work. A key risk would be failing to respond to a request for new data in a reasonable time.
4. For GPES we would look at the use of the query subsystem as a mediator.
5. In doing this we would consider modifiability and consider how easily it is to adapt the system to a new information request.
6. We might look at a scenario where a stakeholder wants to have a new extraction request implemented quickly.

Elaborating on Stage 6 for GPES

- Scenario: Implementing a new extract request
- Attribute: Modifiability
- Environment: Normal Operation
- Stimulus: Stakeholder request for a new extract.
- Response: New extract available within 2 months of request.

Elaborating on Stage 6 for GPES

Arch Decision	Sensitivity	Tradeoff	Risk	Non-risk
Use Mediator				N1
Implement in business logic	S1	T1	R1	
Depend on Vendors	S2		R2	

Elaborating on Stage 6 for GPES

- Reasoning:
  - Mediator ensures each modification can be executed concurrently so this avoids delays in individual systems.
  - Is there a chance that the development time for any of the business logic components could exceed 2 months – the tradeoff is that any alternative is unacceptable to some stakeholders (the vendors in particular).
  - Depending on the vendors accurately to implement the modification may be an issue.

Phase 2 Evaluation

- **Repeat the summary of ATAM**

7. **Brainstorm prioritization of scenarios –** revisit the prioritization for additional scenarios e.g. a particular stakeholder (performance engineer) might propose a scenario on the response time of the system.
8. **Analyze Architectural Approaches –** revisit stage 6 but with an expanded and reprioritized set of scenarios
9. **Present results –** the evaluation group tries to group risks into risk themes to identify systemic issues and results are presented.

ATAM Results

- Documentation of architectural approaches taken by the project.
- Prioritized list of scenarios
- Utility tree
- Risks discovered
- Non-risks identified
- Sensitivity and Tradeoff points identified

Lightweight Version

Step	Time Allotted	Notes
1: Present the ATAM	0 hrs	The participants are familiar with the process. This step may be omitted.
2: Present Business Drivers	0.25 hrs	The participants are expected to understand the system and its business goals and their priorities. Fifteen minutes is allocated for a brief review to ensure that these are fresh in everyone's mind and that there are no surprises.
3: Present Architecture	0.5 hrs	Again, all participants are expected to be familiar with the system and so a brief overview of the architecture, using at least module and C&C views, is presented and 1 to 2 scenarios are traced through these views.
4: Identify Architectural Approaches	0.25 hrs	The architecture approaches for specific quality attribute concerns are identified by the architect. This may be done as a portion of step 3.

Lightweight version (ctd)

4: Identify Architectural Approaches	0.25 hrs	The architecture approaches for specific quality attribute concerns are identified by the architect. This may be done as a portion of step 3.
5: Generate Quality Attribute Utility Tree	Variable 0.5 hrs – 1.5 hrs	Scenarios might exist: part of previous evals, part of design, part of requirements elicitation. If you've got 'em, use 'em and make them into a tree. Half hour. Otherwise, it will take longer. A utility tree should already exist; the team reviews the existing tree and updates it, if needed, with new scenarios, new response goals, or new scenario priorities and risk assessments.
6: Analyze Architectural Approaches	2–3 hrs	This step—mapping the highly ranked scenarios onto the architecture—consumes the bulk of the time and can be expanded or contracted as needed.

Lightweight version (ctd)

7: Brainstorm and Prioritize Scenarios	0 hrs	This step can be omitted as the assembled (internal) stakeholders are expected to contribute scenarios expressing their concerns in step 5.
8: Analyze Architectural Approaches	0 hrs	This step is also omitted, since all analysis is done in step 6.
9: Present Results	0.5 hrs	At the end of an evaluation, the team reviews the existing and newly discovered risks, non-risks, sensitivities, and tradeoffs and discusses whether any new risk themes have arisen.
TOTAL	**4–6 hrs**	

Summary

- The larger and more complex the system the more likely you are to have done explicit architectural design and any design should be evaluated.
- ATAM is comprehensive and attempts to capture project risks.
- ATAM is one approach to this – the standard process is not particularly agile – lightweight process is better.