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Reducing System Acquisition Risk with Software Architecture Analysis and Evaluation

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Software Engineering Institute

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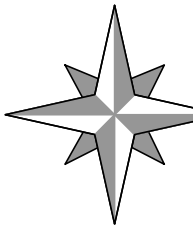


Topics

- Introduction and Motivation
- Architecture analysis methods
- Integrating architecture analysis and evaluation into a system acquisition
- RFP/contract language considerations
- Summary
- References

Software Architecture Definition

The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them.

Reference:
Software Architecture in Practice, 2nd Edition;
Bass, L.; Clements, P.; & Kazman, R. Reading, MA: Addison-Wesley Publishing Co., Spring 2003.

Why Is Software Architecture So Important?

Architecture is a common high-level communication vehicle for system stakeholders that is amenable to analysis and synthesis.

Architecture embodies the earliest set of design decisions about a system. These decisions

- are the most profound
- are the hardest to get right
- ripple through the entire software development effort
- are most costly to fix downstream
- are critical to achieving mission/business goals

The earlier we reason about tradeoffs, the better. Architecture provides a powerful way to predict system qualities.

Being Proactive Pays Off

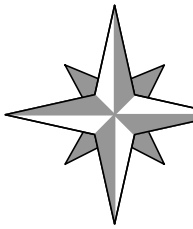
Architecture analysis and evaluation enables an acquisition program to

- **obtain early visibility and technical insight into**
  - **system concept of operation**
  - **system and software design decisions and tradeoffs**
  - **ability to achieve desired system quality attributes**
- **achieve increased stakeholder communication across and within government and contractor organizations**
- **identify and reduce risk early on—for new and legacy systems**

Terminology in This Presentation

Architecture analysis refers to analyzing a system's software architecture in accordance with a prescribed method.

Evaluation is used strictly in an acquisition context—i.e., in reference to performing an appraisal during source selection or contract performance.



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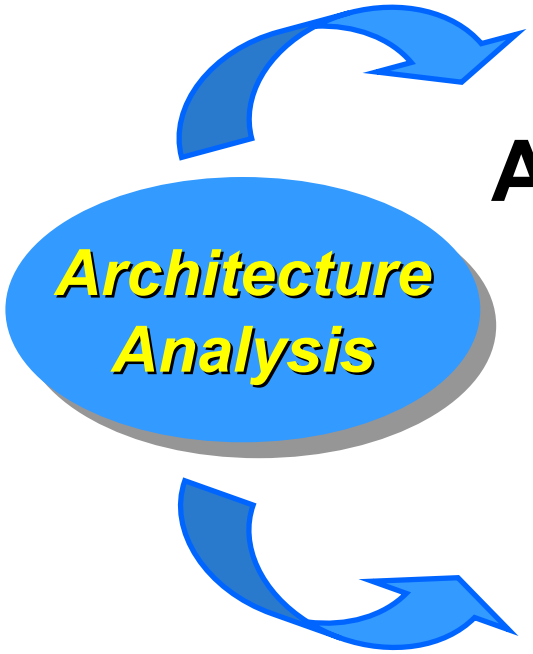
SEI's Architecture Analysis Methods

The term "architecture analysis" encompasses both



ATAM[SM] → Architecture Tradeoff Analysis Method[SM]

QAW → Quality Attribute Workshop

Need to

- ***choose an analysis method that fits your approach***
- ***implement a compatible acquisition infrastructure***

[SM] Architecture Tradeoff Analysis Method and ATAM are service marks of Carnegie Mellon University.

Characteristics of ATAM and QAW

ATAM

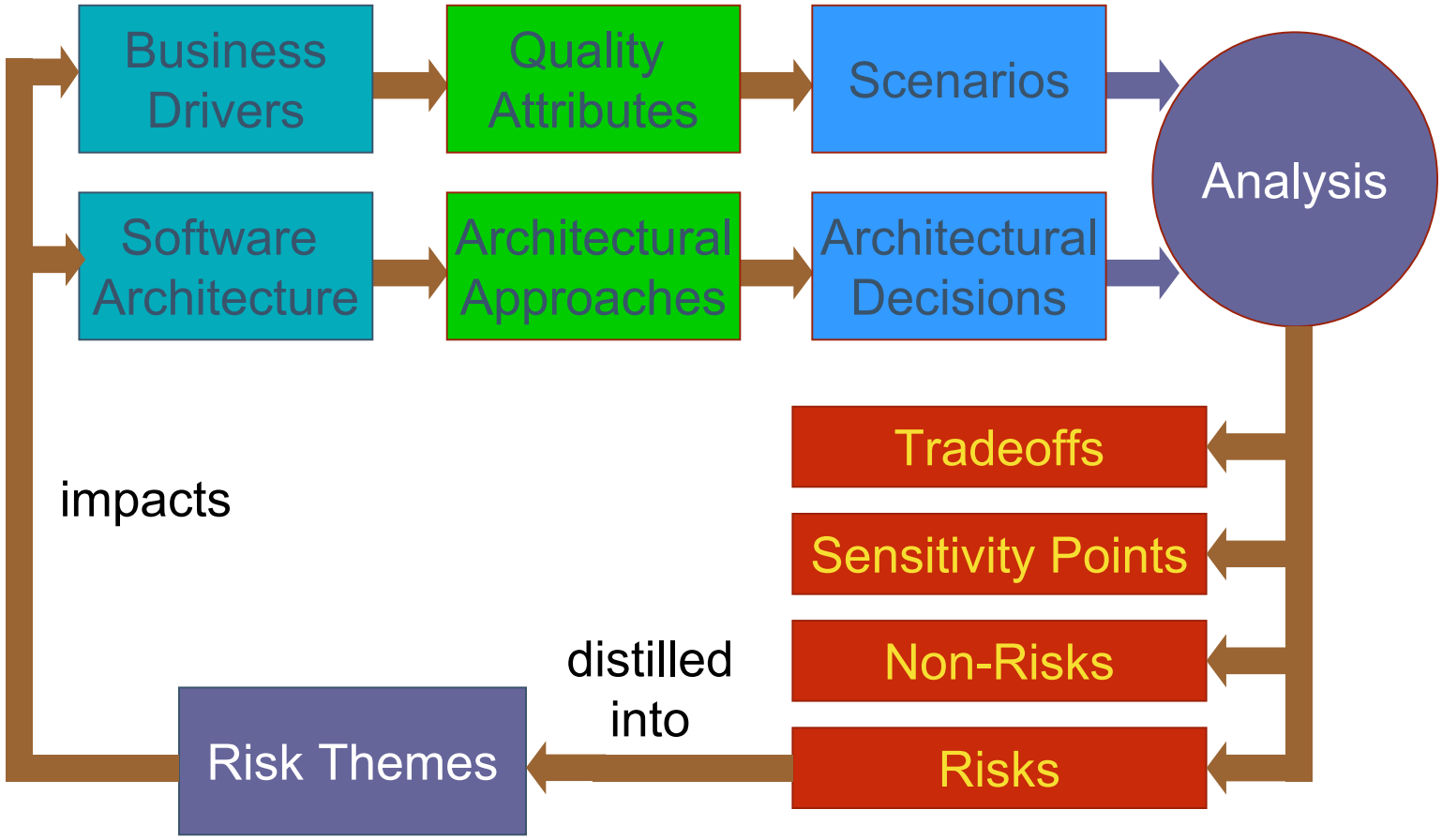
- Analyzes business/mission drivers and software quality attributes against an existing software architecture
- Involves broad range of stakeholders
- Requires close collaboration with architecture development team

QAW

Both emphasize communication with stakeholders

- Complementary offshoot of ATAM
- Intended for early stages of conceptual architecture development
- Can begin while the software architecture is still being crafted
  - Elements of a system and software architecture will suffice.
- Can be done offline by developer

ATAM Overview



Scenarios – 1

Scenarios are used to represent stakeholders' interests and to understand quality attribute requirements.

Scenarios should cover a range of:

- anticipated uses of the system (use case scenarios)
- anticipated changes to the system (growth scenarios)
- unanticipated stresses on the system (exploratory scenarios)

Scenarios are used to drive discussion on how the software architecture "responds."

A good scenario specifies a stimulus, environment, and the response.

Scenarios – 2

Stimuli, Environment, **Responses**

Use Case Scenario:

Remote user requests a database report via the Web **during peak period** and receives it within 5 seconds.

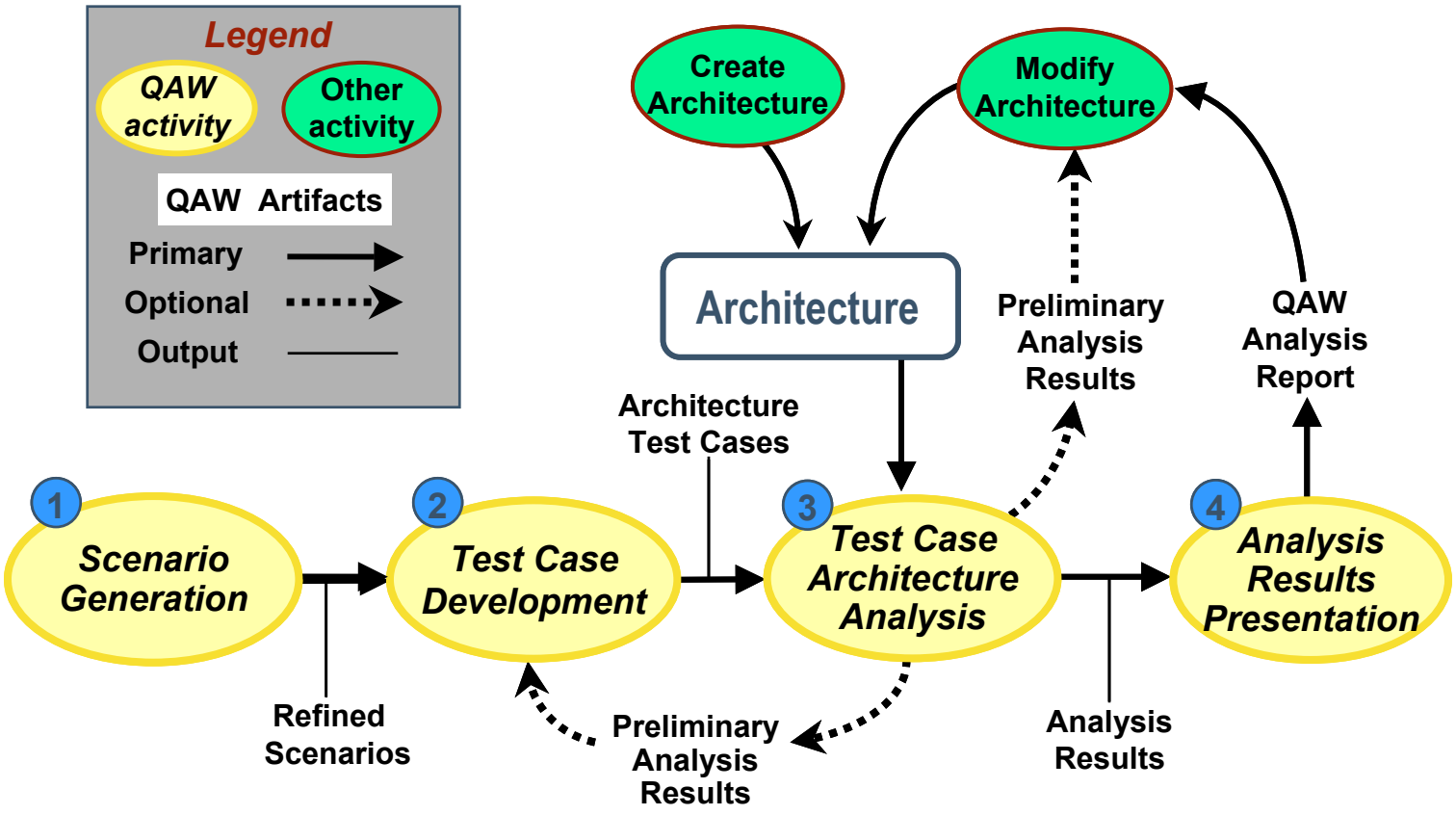
Growth Scenario:

Add a new data server to reduce latency in scenario one to 2.5 seconds within 1 person-week.

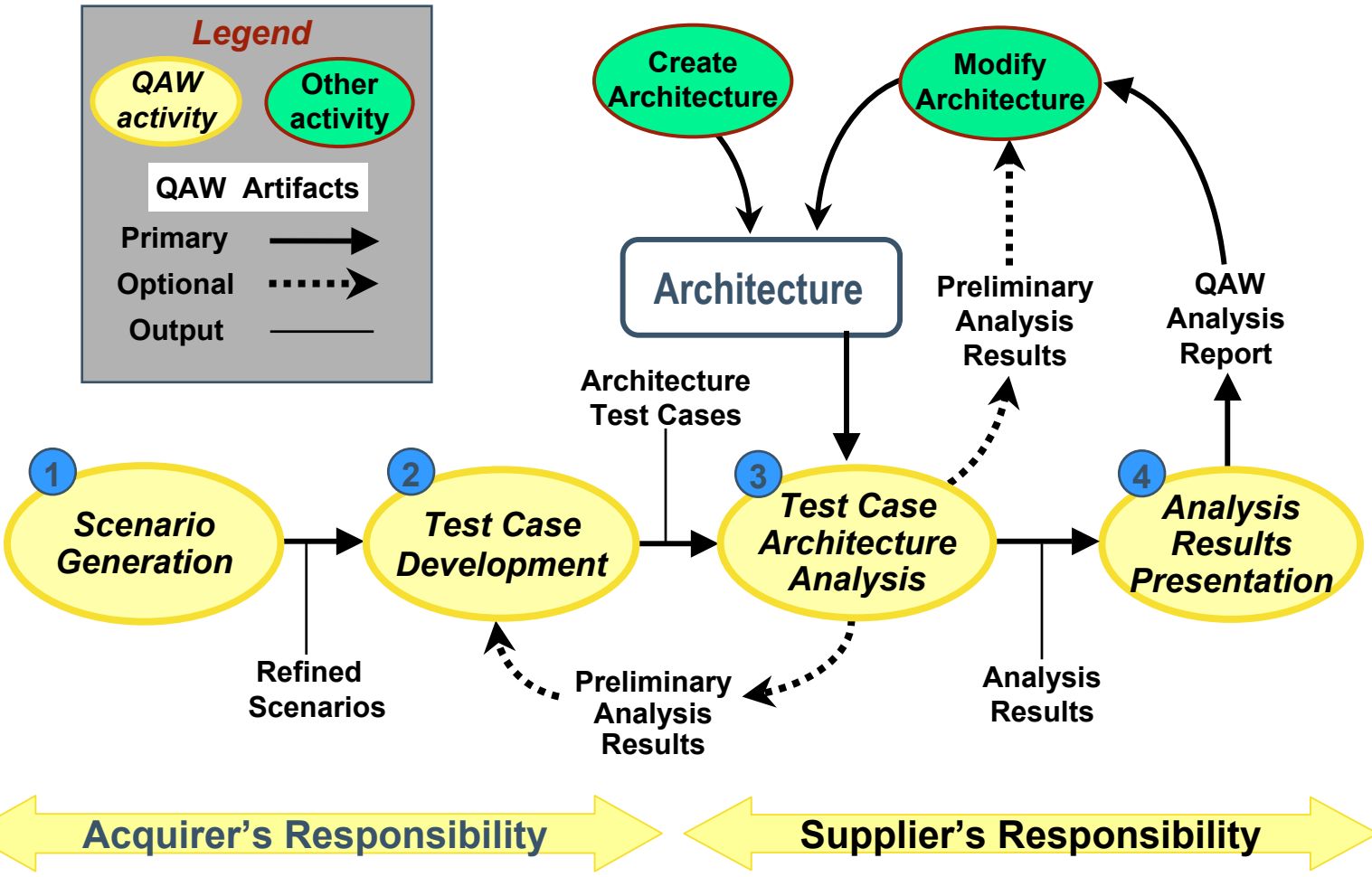
Exploratory Scenario:

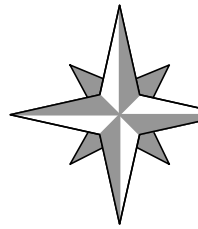
Half of the servers go down **during normal operation** without affecting overall system availability.

QAW Process



QAW Process – In DoD Environment





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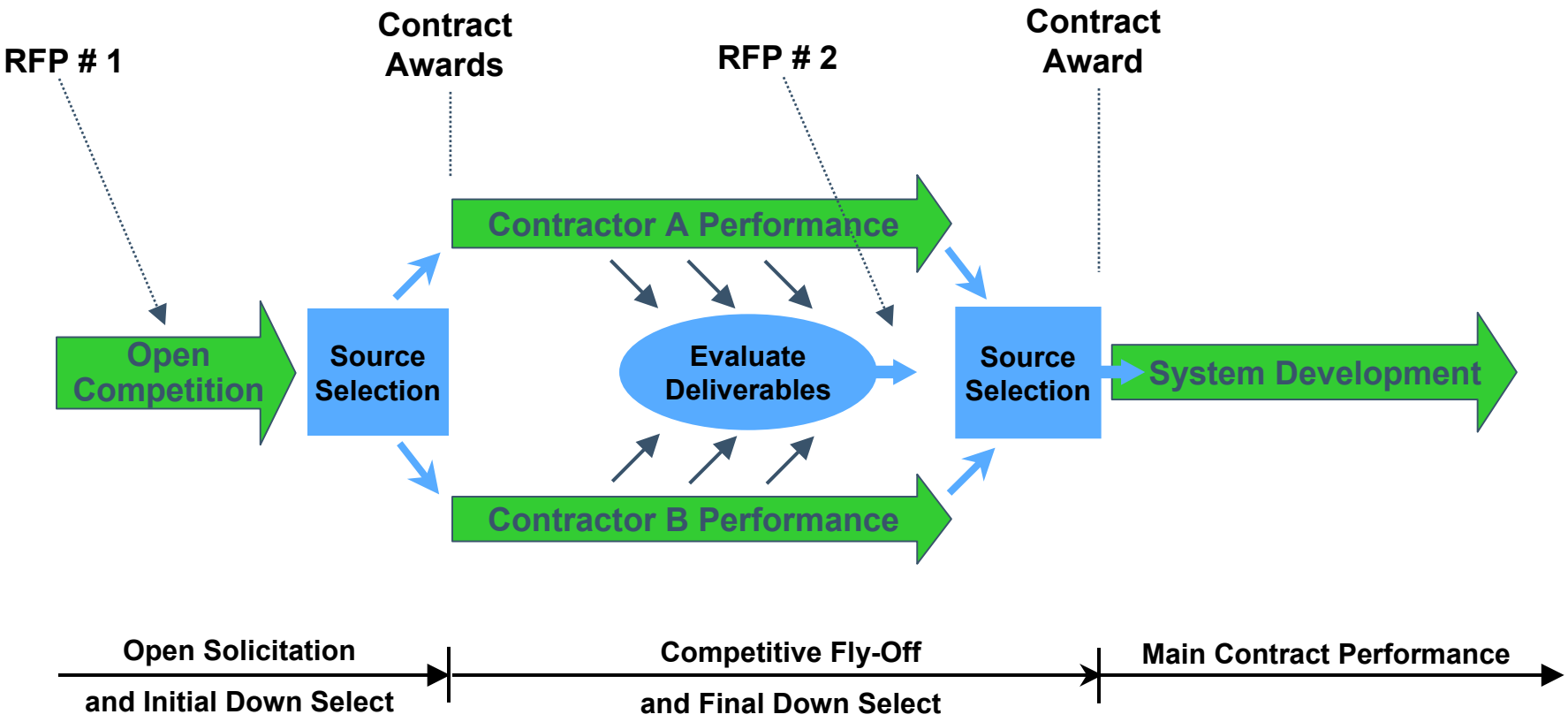
Applying Architecture Analysis and Evaluation in a System Acquisition

In competitive acquisitions, architecture analysis and evaluation can be used to help manage the solicitation process, including source selections.

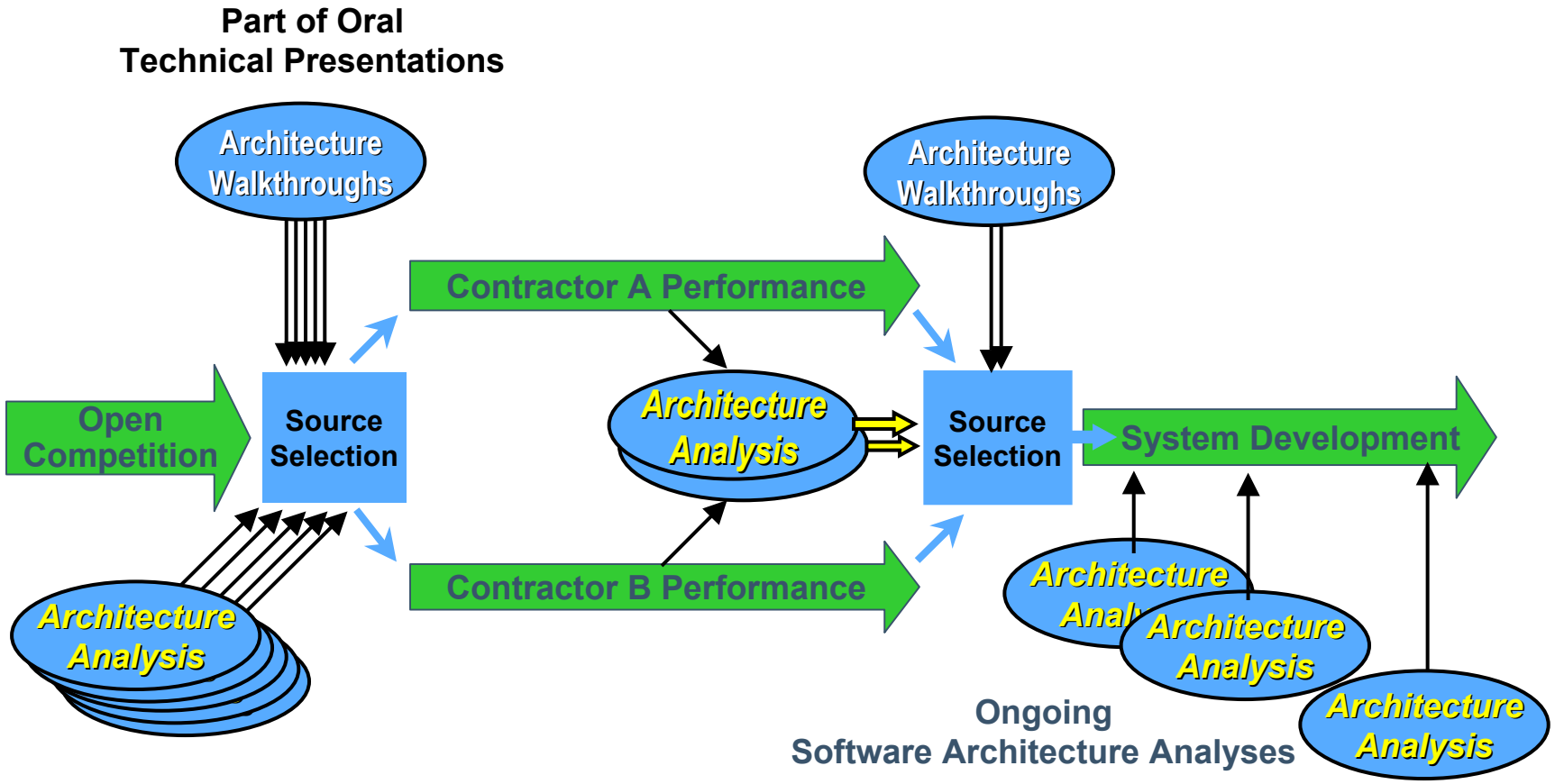
After contract award, architecture analysis can be used to help manage the contract performance process, including contractor performance and product evaluations.

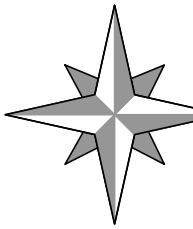
How to use architecture analysis and evaluation most effectively depends on your objectives and system acquisition strategy.

Example System Acquisition Strategy



Potential Application of Architecture Analysis and Evaluation





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Implementing the Architecture Analysis and Evaluation Approach

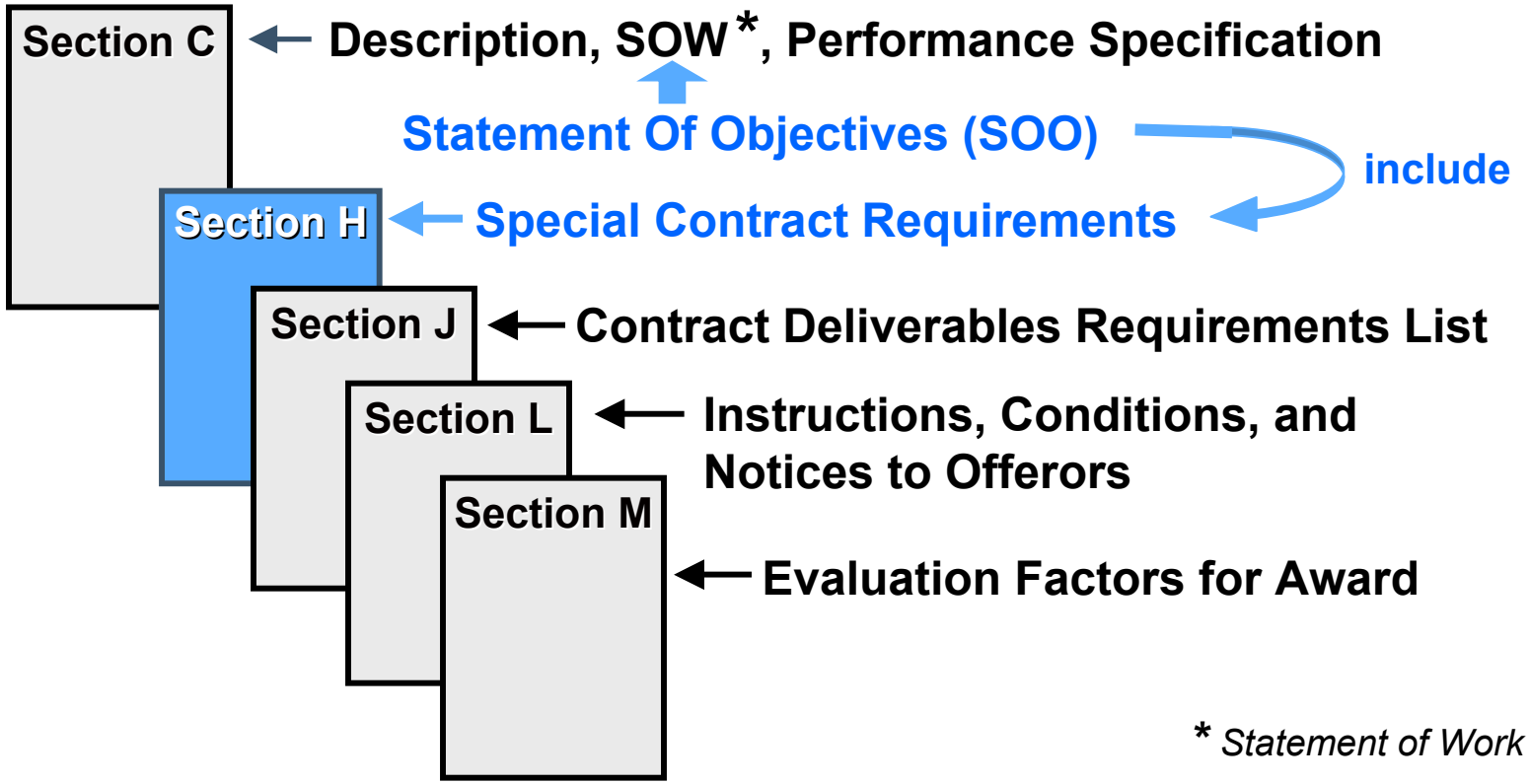
What happens during solicitation and contract performance critically depends on what is included in the RFP and the resulting contract.

Appropriate RFP/contract language must be developed to make architecture analysis and evaluation an integral part of evaluating proposals as well as evaluating system aspects.

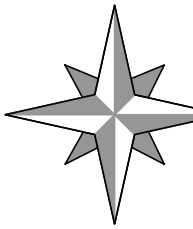
Only the RFP and contract language can give the government the means to manage the suitability of the software architecture.

RFP/Contract Sections

Incorporating architecture analysis requires developing appropriate language for the following sections:



* *Statement of Work*



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Summary

Architecture analysis and evaluation provide an effective means for

- mitigating risks in a system acquisition
- evaluating the achievement of system quality attributes that are important to the program
- changing customary program assumptions about software oversight that underlie system acquisitions

There are proven techniques to support this.

RFP and contract language alone can give the acquirer the capability to manage the system quality of the architecture.

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Technical Notes on Architecture Analysis in Acquisition 1

CMU/SEI-2002-TN-010
Use of the Architecture Tradeoff Analysis Method℠ (ATAM℠) in Source Selection of Software-Intensive Systems

CMU/SEI-2002-TN-013
Use of Quality Attribute Workshop (QAW) in Source Selection for a DoD System Acquisition: A Case Study

CMU/SEI-2001-TN-010
Use of the Architecture Tradeoff Analysis Method℠ (ATAM℠) in the Acquisition of Software-Intensive Systems

Technical Notes on Architecture Analysis in Acquisition 2

CMU/SEI-2000-TN-010
Using Quality Attribute Workshops to Evaluate Architectural Design Approaches in a Major System Acquisition: A Case Study

CMU/SEI-99-TN-012
Software Architecture Evaluation with ATAM[SM] in the DoD System Acquisition Context

Related Technical Notes and Reports

CMU/SEI-2001-TN-022
Using the Architecture Tradeoff Analysis Method℠ to Evaluate a War Game Simulation System: A Case Study

CMU/SEI-2000-TN-007
Using the Architecture Tradeoff Analysis Method℠ to Evaluate a Reference Architecture: A Case Study

CMU/SEI-99-TR-014
Architecture Tradeoff Analyses of C4ISR Products

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